United States
Department of
Agriculture

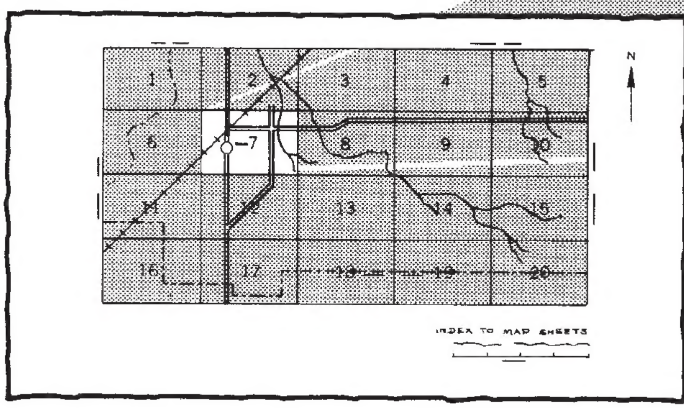
Soil
Conservation
Service

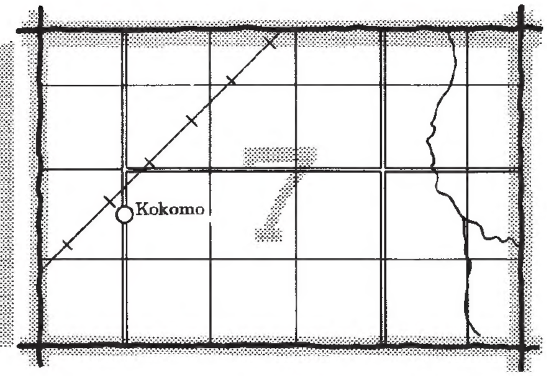
In cooperation with
United States Department
of the Interior, Bureau
of Indian Affairs, and
Oregon Agricultural
Experiment Station

Soil Survey of Umatilla County Area, Oregon

HOW TO USE

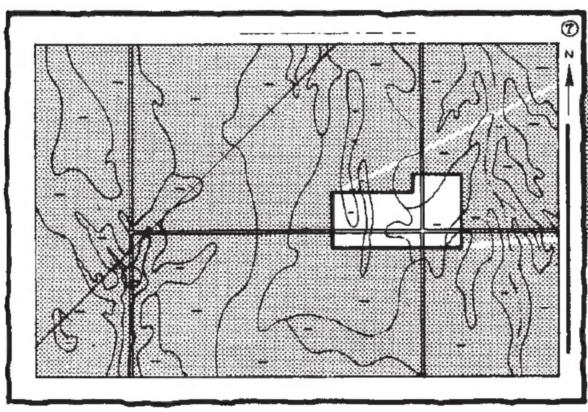
1. Locate your area of interest on the "Index to Map Sheets."

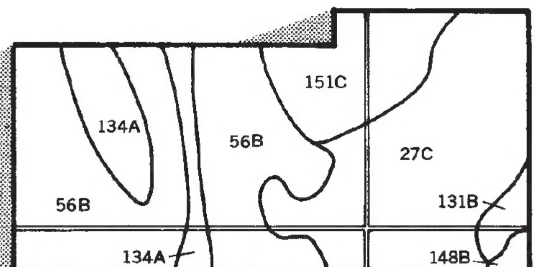




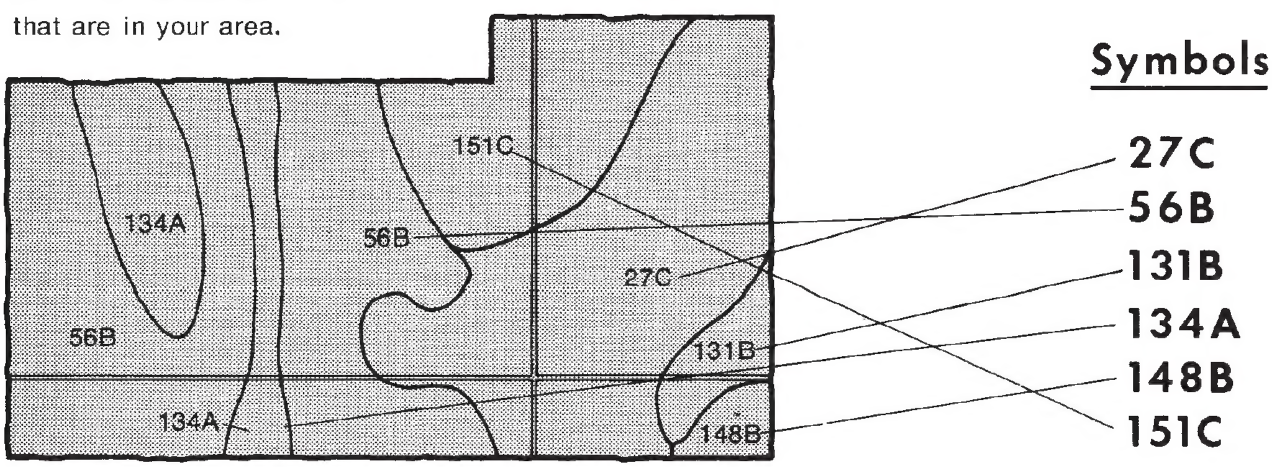
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



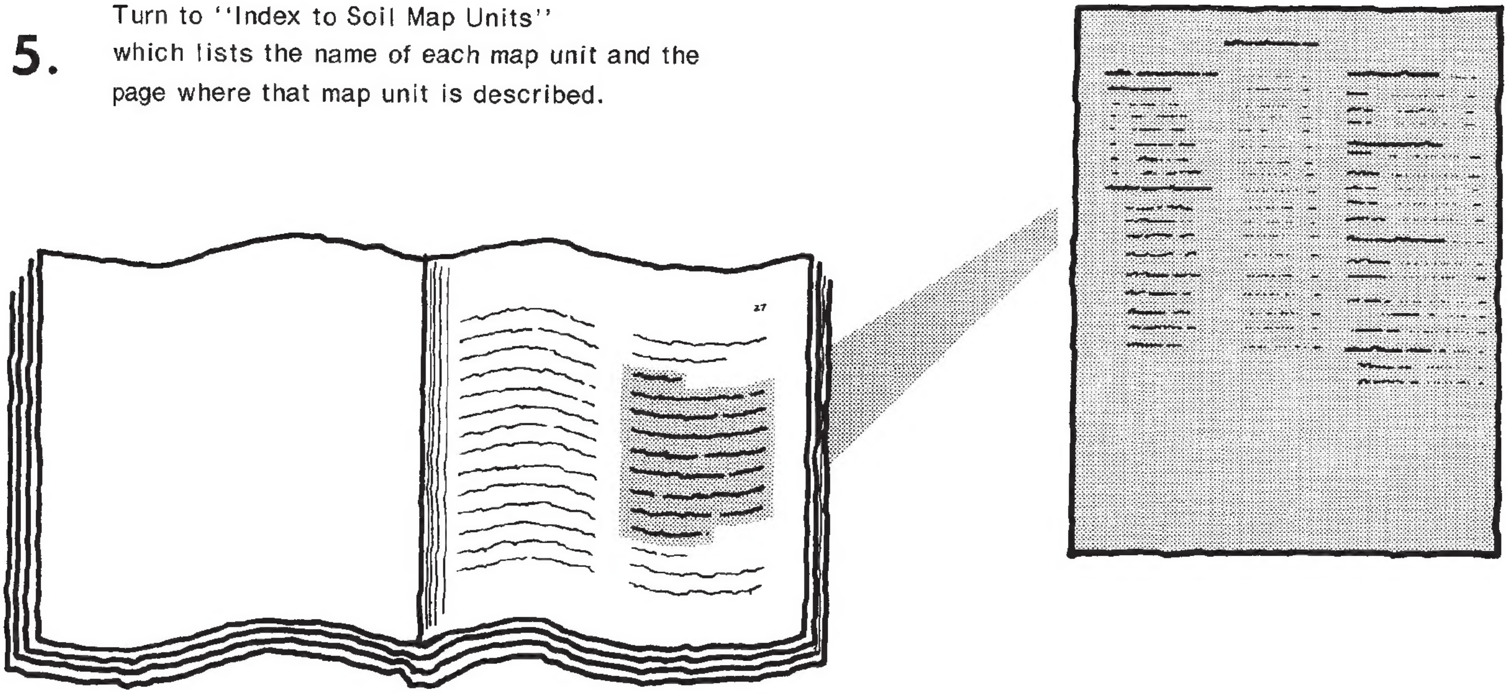


4. List the map unit symbols that are in your area.

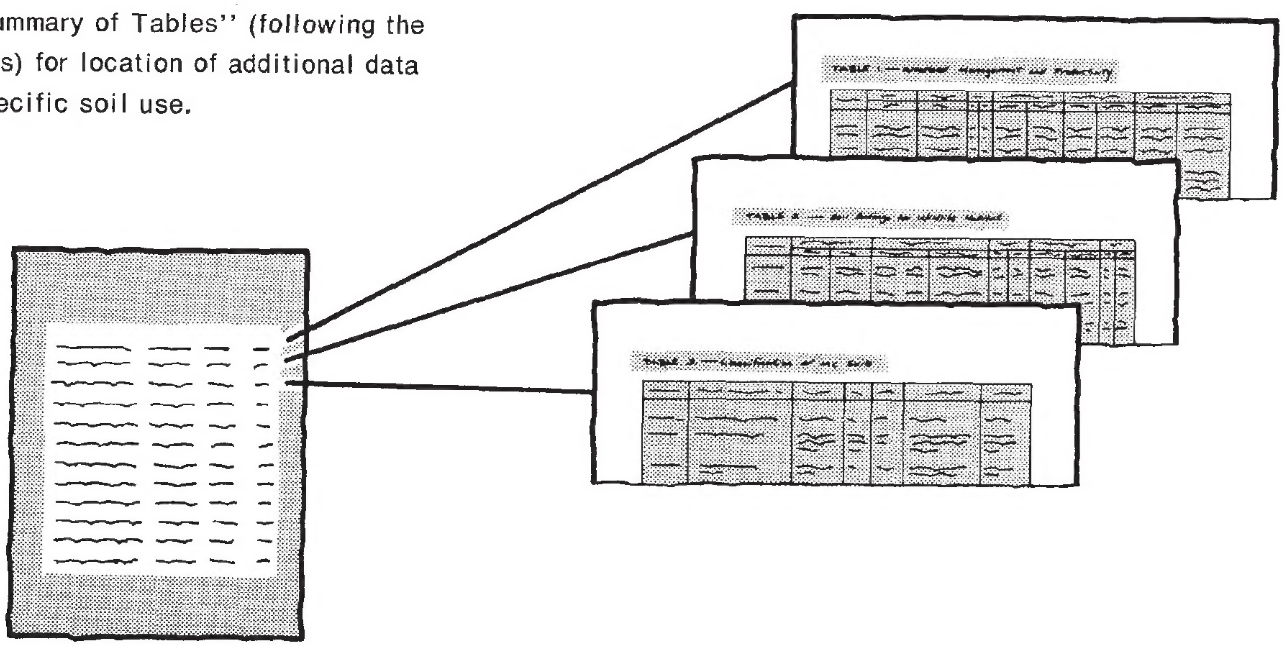


THIS SOIL SURVEY

5. Turn to ''Index to Soil Map Units'' which lists the name of each map unit and the page where that map unit is described.



6. See ''Summary of Tables'' (following the Contents) for location of additional data on a specific soil use.



7. Consult ''Contents'' for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service, the Bureau of Indian Affairs, the Oregon Agricultural Experiment Station, and the County of Umatilla. It is part of the technical assistance furnished to the Umatilla County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Waha and Rockly soils in cultivated areas on ridges; Bowlus and Buckcreek soils in draws.

Contents

Taxonomic units

Issued November 1988

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Summary of Tables

Foreword

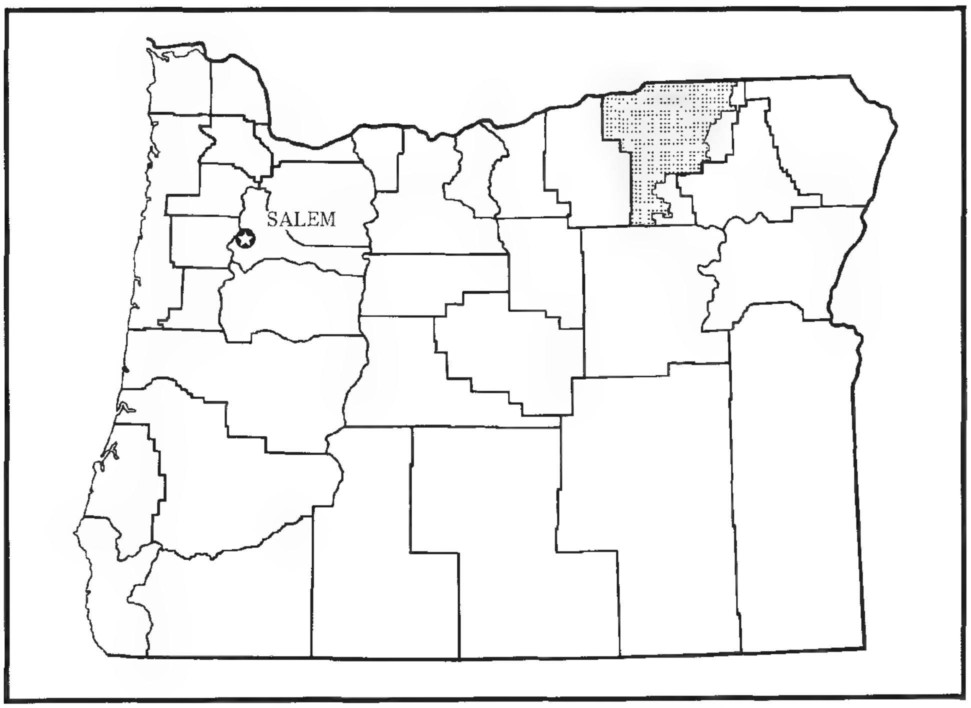
This soil survey contains information that can be used in land-planning programs in Umatilla County Area. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Jack P. Kanalz
State Conservationist
Soil Conservation Service



Location of Umatilla County Area in Oregon.

Soil Survey of Umatilla County Area, Oregon

By David R. Johnson and Allen J. Makinson, Soil Conservation Service

Fieldwork by David R. Johnson, Allen J. Makinson, Aimee E. Walker, Duane K. Monte, and Joe S. Cahoon, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with
United States Department of the Interior, Bureau of Indian Affairs, and
Oregon Agricultural Experiment Station

UMATILLA COUNTY AREA is in the northeastern part of Oregon. The survey area does not include any part of the Umatilla National Forest. It has a total area of about 1,653,951 acres. Pendleton is the county seat of Umatilla County. The county has a population of about 60,000, most of which is directly or indirectly dependent upon farming, ranching, food processing, or timber production. Umatilla County is one of the leading agricultural counties in Oregon.

About 35 percent of the survey area is used for nonirrigated wheat or other small grain, about 35 percent is rangeland, about 15 percent is commercial woodland, and 5 percent is irrigated cropland. Nonirrigated and irrigated wheat produce nearly half of the county's gross agricultural cash income.

Soil scientists have determined that there are about 75 different kinds of soil in the survey area. Each soil may have several different slope, texture, aspect, or other features. The soils range from coarse sand to heavy clay in texture and from volcanic ash that is low in fertility to deep loess that is high in fertility. Restricted soil depth, steepness of slope, and low rainfall are the main limitations for growing nonirrigated crops.

An older survey, "Umatilla County Area, Oregon," was published in 1948 (*24*). This earlier survey covers a part of the present survey. The present survey, however, updates the earlier survey and provides additional information and larger maps that show the soils in greater detail.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent survey areas. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey.

General Nature of the Survey Area

This section briefly discusses the history, agricultural development, physiography and geology, and climate in the survey area.

History

The Cayuse, Umatilla, and Walla Walla Indian tribes were inhabiting the survey area when the first white settlers arrived. Agricultural activities by these tribes consisted only of cultivating a few small acreages of maize and other edible seed crops. Large herds of horses had been accumulated by some chiefs by the middle of the 19th century. The foothills of the Blue Mountains provided excellent grazing for these herds. The brush was burned to sustain growth of the lush bunchgrasses in this region. Hunting of big game animals and fishing for salmon and steelhead along the Umatilla and Columbia Rivers provided an ample supply of food for the tribes in the survey area.

The first permanent white residents settled in Umatilla County after the opening of the Oregon Trail in 1843. In 1847 an Indian mission was established near the present site of Pendleton. It was abandoned a few months later because of the hostility of the Indians. An Indian agency was established near Echo. Other settlements were started at the mouth of McKay Creek and near Umapine in the Walla Walla River Valley. Some of these settlements were destroyed during the Indian War of 1855-57. In 1855 the United States Government set aside a reservation for the Cayuse, Walla Walla, and Umatilla Indians in the survey area.

In 1861 gold was discovered near Boise, Idaho, and later gold was mined along the Powder River. Settlements were established along the Umatilla and Walla Walla Rivers to supply the miners, and these areas grew as mining activities increased. The settlers at this time were mainly interested in raising cattle and sheep and providing other food supplies.

Nonirrigated farming was conducted on a small scale until the railroad was built in 1883. Farm acreage increased because of the ease of shipment by railroad and because of inventions such as the combine harvester and steam powered tractor.

In 1879 some 45,000 acres was used for grain; by 1909, 215,000 acres was being farmed. At the same time the number of sheep in the county was steadily decreasing. In 1880 more than 250,000 sheep were grazing on the rangelands of the county. The level of potato and fruit production throughout the first half of the century was only a small fraction of what it is today.

After the turn of the century, most of the area to the east and northeast of Pendleton was used for annual grain production and the area to the west was farmed using a grain-fallow cropping system. Ranchers were forced to graze their cattle and sheep on soils not suited to growing grain. During World War I and following it, many of these soils were cultivated, seeded, and later abandoned because they were not economical to farm.

The towns established in the early 1900's were built to serve the needs of the surrounding farms. Pendleton became an important shipping point for grain, lumber, and other products produced in the area.

Agricultural Development

Irrigation was initially used only on small acreages, commonly next to farmhouses, until large irrigation districts were organized in 1900. Several thousand acres was irrigated in the Walla Walla River Valley and around the towns of Hermiston and Stanfield. After the turn of the century crops such as fruit and small grain were grown.

Several irrigation projects were completed in the early part of the century, which provided water for irrigating some 12,000 acres of arid sandy soils in the western part of the county. In 1903 the Westland Irrigation District began delivering water. In 1908 the first water was delivered to the Hermiston Irrigation District from Cold Springs Reservoir. In 1917 the West Extension Irrigation District was formed, and in 1927 McKay Reservoir was completed (*21*).

In the Walla Walla River Valley irrigation began in 1862, and by 1891 about 2,500 acres of irrigated land was in production. By 1935 this figure had risen to 11,000 acres.

After World War II McNary Dam was built, along with a system of locks along the Columbia River; this enabled barges to carry large wheat shipments. Hydroelectric power was inexpensive, and in the late 1960's extensive irrigation systems were planned that could pump large amounts of water to irrigate the many acres of arid sands along the Columbia River. With the development of the center pivot sprinkler system, large acreages of land could be irrigated quickly with little labor. From 1969 to 1974 the irrigated acreage increased 30 percent countywide. In 1969 only 10 center pivot systems were in operation in the northern part of Umatilla, Morrow, and Gilliam Counties (*11*). In 1975 about 20 percent of the acreage in Umatilla County was irrigated with water from the Columbia River. The remaining area was irrigated by water from deep aquifers. The use of this ancient water has had to be controlled to prevent a drop in the permanent water table.

Physiography and Geology

The survey area is within four major land resource areas: The Columbia Basin, Columbia Plateau, Palouse and Nez Perce Prairies (foothills of the Blue Mountains), and Northern Rocky Mountains (Blue Mountains).

The soils of the Columbia Basin are in gently sloping areas on terraces. They formed in old alluvial deposits that have been reworked by wind. Elevation ranges from 250 feet to about 1,500 feet.

The soils of the Columbia Plateau are on hills, in gently sloping areas on terraces, and on steep hillslopes that are mantled by windblown silt. Elevation ranges from about 500 to 3,100 feet.

The soils on the foothills of the Blue Mountains are in gently sloping areas on ridgetops and in very steep areas on hillslopes. The Columbia River Basin has been uplifted, folded, and dissected by streams. Elevation ranges from 1,500 to 4,500 feet.

The soils of the Blue Mountains are in gently sloping areas on plateaus and ridgetops and in very steep areas on hillslopes. They are mainly in an area of uplifted basalt, characterized by remnant plateaus. Ash deposited during past volcanic activity in the Cascades has accumulated in some areas. Elevation ranges from 3,000 to 5,200 feet.

The Blue Mountains have divided the survey area into three watersheds, which eventually drain into the Columbia River. The Umatilla River drains about 75

percent of the survey area. The Walla Walla River watershed drains the northern part of the survey area, and the North Fork of the John Day River drains the southern part.

Climate

By the National Climatic Center, Asheville, North Carolina.

The Rocky Mountains partly shield the survey area from strong arctic winds, so winters generally are not too severe, though cold. In summer winds from over the Pacific Ocean are partially blocked. Days are hot, but nights are fairly cool. Precipitation, except in mountainous areas, is scant in summer, but in many places it is adequate during the cooler parts of the year to produce nonirrigated small grain crops or range plants. The snowpack that accumulates at high elevations supplies irrigation water for intensive farming in some parts of the survey area.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Hermiston and Pendleton, Oregon, for the period 1951-81 and at Meacham, Oregon, for the period 1951-75. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperatures at Hermiston, Meacham, and Pendleton are 35, 29, and 36 degrees F, respectively. The average daily minimum temperature is 27 degrees at Hermiston, 23 degrees at Meacham, and 29 degrees at Pendleton. The lowest temperature occurred at Hermiston on January 26, 1957, and is -31 degrees. In summer the average temperature is 60 degrees at Meacham and 71 degrees at both Hermiston and Pendleton. The average daily maximum temperature is 73 degrees at Meacham and 85 degrees at both Pendleton and Hermiston. The highest recorded temperature occurred at Hermiston on August 5, 1961, and at Pendleton on August 4, 1961, and is 113 degrees.

Growing degrees days, shown in table 1, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 9 inches at Hermiston, 33 inches at Meacham, and 12 inches at Pendleton. Of this, 30 percent usually falls in April through September, which includes the growing season for most crops. The heaviest 1-day rainfall during the period of record was 3.36 inches at Hermiston on October 2, 1957. Thunderstorms occur on about 10 days each year, and most occur in summer.

Average seasonal snowfall is 11 inches at Hermiston, 146 inches at Meacham, and 18 inches at Pendleton. The greatest snow depth at any one time during the period of record was 50 inches at Meacham. On the average, Hermiston and Pendleton have 9 to 12 days with at least 1 inch of snow on the ground while Meacham has 65 days with at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The percentage of possible sunshine is 80 percent in summer and 25 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge gradually onto one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to

verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While the soil survey was in progress, samples of some of the soils in the area were collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses and under different levels of management. Some interpretations were modified to fit local conditions, and some new interpretations were developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Survey Procedures

Most of the survey area was mapped on preliminary field sheets at a scale of 1:15,840, and then the information was transferred to orthophotoquads at a scale of 1:20,000. Cultural features were transferred from U.S. Geological Survey 7.5-minute topographic maps. Hillslopes generally were determined from contour intervals on topographic maps.

Transects were used to map level soils in areas without easily predictable patterns, such as those on flood plains and terraces of eolian sand. Tonal patterns on aerial photos were used to predict some preliminary soil delineations. The extent and composition of each map unit were determined with line intercept transects. The transect lines and field samples were taken at regular intervals, usually crossing several delineations on a single geomorphic surface. The minimum size delineation is about 5 acres for strongly contrasting soils. Spot symbols are used for areas of contrasting soils or miscellaneous areas that are less than 5 acres in size or are described as inclusions in the map unit description.

In areas used for small grain-fallow and annual cropping, traverses were used to establish the soil-landform models used in soil mapping. Photo interpretation and field investigation were of an intensity sufficient to detect 40-acre areas that needed significantly different management if used as nonirrigated cropland.

The specifications for mapping in the rangeland and woodland areas were similar. No transects were done, and only half as many landform traverses were made as in the cropland areas. The minimum size of most mapped areas is about 100 acres, although smaller areas were mapped where the soils are strongly contrasting.

Slope estimates were made from topographic maps. Photo interpretation of tonal patterns was used to delineate many of the map units in the rangeland and woodland areas. Tree density was used to determine the location of highly productive volcanic ash soils in the woodland areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils or miscellaneous areas can be identified on the map. Likewise, areas that are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general map units in this survey have been grouped into general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

Map Unit Descriptions

Soils that formed in alluvium on flood plains and terraces

This group consists of two map units. It makes up about 3 percent of the survey area.

1. Powder-Umapine-Pedigo

Deep, well drained to somewhat poorly drained soils that formed in silty alluvium; on flood plains and terraces

This map unit has slopes of 0 to 3 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 500 to 900 feet. The mean annual precipitation is about 9 to 12 inches. The mean annual air temperature is 50 to 54 degrees F, and the average frost-free period is 160 to 195 days.

This unit makes up about 1 percent of the survey area. It is about 37 percent Powder soils, 11 percent Umapine soils, and 8 percent Pedigo soils. Of minor extent are the rarely flooded Yakima and Esquatzel soils on flood plains and the Stanfield soils on terraces.

The Powder soils are rarely flooded and well drained. They are on flood plains. The surface layer, subsoil, and substratum are silt loam.

The Umapine soils are moderately well drained. They are on terraces. The surface layer is silt loam, the subsoil is very fine sandy loam, and the substratum is very fine sandy loam and silt loam.

The Pedigo soils are rarely flooded and somewhat poorly drained. They are on flood plains. The surface layer and underlying material are silt loam.

Most of this unit is used for irrigated crops such as alfalfa hay, corn, and small grain.

The Powder and Umapine soils have few limitations. The Pedigo soils are limited by wetness and high content of sodium.

2. Freewater-Hermiston-Xerofluvents

Deep, excessively drained to somewhat poorly drained soils that formed in alluvium; on flood plains

This map unit has slopes of 0 to 3 percent. The native vegetation in areas not cultivated is mainly grasses, shrubs, and forbs. It is deciduous and coniferous trees in areas that have a high water table. Elevation is 700 to 2,000 feet. The mean annual precipitation is about 11 to 30 inches, the mean annual temperature is 45 to 54 degrees F, and the average frost-free period is 110 to 195 days.

This unit makes up about 2 percent of the survey area. It is about 23 percent Freewater soils, 19 percent Hermiston soils, and 15 percent Xerofluvents. Of minor extent are the rarely flooded Veazie soils, the Yakima and Onyx soils, and the Umapine soils on terraces.

The Freewater soils are rarely flooded and somewhat excessively drained. They formed in alluvium. The surface layer is very cobbly loam, and the substratum is extremely gravelly sand.

The Hermiston soils are rarely flooded and well drained. They formed in silty alluvium. The surface layer and subsoil are silt loam.

Xerofluvents are frequently flooded and are somewhat poorly drained to excessively drained. They formed in alluvium. These soils vary in texture of the surface layer and rock fragment content.

Most of this unit is used for irrigated crops such as tree fruit, alfalfa hay, and small grain.

The Hermiston soils have few limitations. The Freewater soils are limited by a high content of rock fragments on the surface and in the profile, very rapid permeability, and low available water capacity. Cobbles on the surface interfere with tillage. The Xerofluvents are frequently flooded and are limited for most uses other than wildlife habitat and pasture.

Soils that formed in eolian sand, loess, alluvium, and lacustrine sediment on terraces of the Columbia River

This group consists of three map units. It makes up about 9 percent of the survey area.

3. Quincy-Starbuck-Rock outcrop

Deep and shallow, excessively drained and well drained soils that formed in eolian sand and loess, and Rock outcrop; on strath terraces

This unit has slopes of 0 to 25 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 450 to 1,200 feet. The mean annual precipitation is about 8 to 10 inches. The mean annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit makes up about 1 percent of the survey area. It is about 34 percent Quincy soils, 22 percent Starbuck soils, and 15 percent Rock outcrop. Of minor extent are the excessively drained Winchester and Quinton soils, the very steep Xeric Torriorthents, and the poorly drained Wanser soils in depressional areas.

The Quincy soils are deep and excessively drained. They formed in eolian sand. The surface layer and substratum are fine sand and loamy fine sand.

The Starbuck soils are shallow and well drained. They formed in eolian sand and loess. The surface layer is very fine sandy loam. The subsoil is fine sandy loam over bedrock.

Rock outcrop consists of areas of exposed basalt intermingled with soils.

Most of this unit is used as rangeland and pastureland. A few areas are used for recreational development. Some areas of the Starbuck soils are flood irrigated to increase production of forage.

The main limitations for this unit are the hazard of soil blowing, depth to bedrock, steepness of slope, and low rainfall. In rangeland areas heavy use can significantly reduce forage production and increase the risk of soil blowing.

4. Quincy-Winchester-Burbank

Deep, excessively drained soils that formed in eolian sand and gravelly alluvium; on terraces

This unit has slopes of 0 to 25 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 300 to 1,500 feet. The mean annual precipitation is about 8 to 10 inches. The mean annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit makes up about 4 percent of the survey area. It is about 46 percent Quincy soils, 15 percent Winchester soils, and 12 percent Burbank soils. Of minor extent are the poorly drained Wanser soils in depressional areas, the well drained Adkins soils, and areas of Dune land.

The Quincy soils formed in eolian sand and gravelly alluvium. The surface layer and substratum are fine sand and loamy fine sand. Some areas have a gravelly substratum.

The Winchester soils formed in eolian sand. The surface layer and substratum are sand.

The Burbank soils formed in eolian sand and gravelly alluvium. The surface layer is loamy fine sand. The substratum is extremely gravelly sand.

Most of this unit is used for irrigated crops such as corn, Irish potatoes, small grain, and alfalfa hay. Center pivot irrigation is most commonly used to provide light and frequent application of water and nutrients. Some areas are used for small grain-fallow cropping and as rangeland.

The soils in this unit are limited by low natural fertility, low available water capacity, rapid permeability, and the hazard of soil blowing. Low rainfall is a limitation in areas of rangeland and nonirrigated cropland.

5. Adkins-Sagehill-Quincy

Deep, well drained and excessively drained soils that formed in eolian sand, gravelly alluvium, and lacustrine sediment; on terraces

This unit has slopes of 0 to 25 percent. The native vegetation in areas not cultivated is mainly grasses, shrubs, and forbs. Elevation is 400 to 1,100 feet. The mean annual precipitation is about 8 to 10 inches. The mean annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit makes up about 4 percent of the survey area. It is about 44 percent Adkins soils, 19 percent Sagehill soils, and 15 percent Quincy soils. Of minor extent are moderately deep Taunton soils on high terraces, Kimberly soils, and Xerofluvents on flood plains.

The Adkins soils are well drained. They formed in eolian sand and gravelly alluvium. The surface layer, subsoil, and substratum are fine sandy loam. Some areas have a gravelly substratum.

The Sagehill soils are well drained. They formed in lacustrine sediment mantled by eolian sand. The surface layer and subsoil are fine sandy loam. The substratum is very fine sandy loam and silt loam.

The Quincy soils are excessively drained. They formed in eolian sand and gravelly alluvium. The surface layer

and substratum are fine sand and loamy fine sand. Some areas have a gravelly substratum.

Most of this unit is used for irrigated crops such as corn, alfalfa hay, small grain, and Irish potatoes. Center pivot irrigation is most commonly used to provide light and frequent applications of water and nutrients. Some areas are used for small grain-fallow cropping and as rangeland.

This unit is limited by low natural fertility, low available water capacity, and a hazard of soil blowing. Low rainfall is a limitation in areas of rangeland and nonirrigated cropland.

Soils that formed in loess, lacustrine sediment, and alluvium on hills, terraces, fan terraces, and piedmonts

This group consists of six map units. It makes up about 33 percent of the survey area.

6. Shano-Burke

Deep and moderately deep, well drained soils that formed in loess overlying lacustrine sediment and cemented alluvium; on fan terraces

This unit has slopes of 1 to 40 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 650 to 1,500 feet. The mean annual precipitation is about 8 to 10 inches. The mean annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

This unit makes up about 6 percent of the survey area. It is about 69 percent Shano soils and 21 percent Burke soils. Of minor extent are the moderately deep Prosser soils, the shallow Lickskillet soils, and the Kimberly soils on flood plains.

The Shano soils are deep. They formed in loess overlying lacustrine sediment. The surface layer is very fine sandy loam and coarse silt loam. The subsoil and substratum are coarse silt loam.

The Burke soils are moderately deep. They formed in loess overlying cemented alluvium. The surface layer and subsoil are coarse silt loam. The substratum is silt loam over a hardpan.

Most of this unit is used for small grain-fallow cropping. A few areas are used for irrigated crops such as corn, alfalfa hay, small grain, and Irish potatoes. Areas not cropped are used as rangeland.

This unit is limited by the hazard of water erosion, low rainfall, and the hazard of soil blowing. The Burke soils are also limited by the depth to a hardpan.

7. Ritzville

Deep, well drained soils that formed in loess; on hills

This unit has slopes of 0 to 50 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 900 to 1,900 feet. The mean annual precipitation is about 10 to 12 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 150 to 170 days.

This unit makes up about 8 percent of the survey area. It is about 70 percent Ritzville soils. Of minor extent are the moderately deep Mikkalo soils, the shallow Lickskillet soils, the deep Nansene soils, and the moderately deep Willis soils.

The Ritzville soils have a surface layer of very fine sandy loam and silt loam. The subsoil and substratum are silt loam.

Most of this unit is used for small grain-fallow cropping. A few areas are used for irrigated crops such as corn, alfalfa hay, small grain, and potatoes. Areas not cropped are used as rangeland.

The main limitations of this unit are low rainfall if nonirrigated crops are grown and the hazards of soil blowing and water erosion.

8. Oliphant-Ellisforde

Deep, well drained soils that formed in loess overlying lacustrine sediment; on terraces

This unit has slopes of 0 to 25 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 500 to 1,500 feet. The mean annual precipitation is 8 to 16 inches, the mean annual air temperature is 50 to 54 degrees F, and the frost-free period is 135 to 190 days.

This unit makes up about 1 percent of the survey area. It is about 36 percent Oliphant soils and 34 percent Ellisforde soils. Of minor extent are the eroded Oliphant and Ellisforde soils on shoulder slopes and the Esquatzel, Kimberly, Hermiston, and Freewater soils on flood plains.

The Oliphant soils have a surface layer and subsoil of silt loam and a substratum of gravelly silt loam.

The Ellisforde soils have a surface layer and subsoil of silt loam and a substratum of laminated silt.

Most of this unit is used for irrigated crops such as small grain, peas, and alfalfa seed. Some areas are used for growing tree fruit and nonirrigated small grain.

This unit is limited mainly by low rainfall in areas used for nonirrigated cropping and by the hazard of water erosion in the steeper areas.

9. Walla Walla

Deep, well drained, soils that formed in loess; on hills

This unit has slopes of 1 to 40 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 1,000 to 2,300 feet. The mean annual precipitation is 12 to 15 inches, the mean annual air temperature is about 50 to 53 degrees F, and the frost-free period is 135 to 170 days.

This unit makes up about 14 percent of the survey area. It is about 87 percent Walla Walla soils. Of minor extent are the moderately deep Anderly soils, the

shallow Lickskillet soils, the deep Nansene soils, and the Hermiston soils on flood plains.

The Walla Walla soils have a surface layer, subsoil, and substratum of silt loam.

Most of this unit is used for small grain-fallow cropping. A few areas are used for irrigated crops such as alfalfa hay and small grain. Areas not cropped are used as rangeland.

This unit is limited mainly by the hazard of water erosion in the steeper areas and by low rainfall in areas of nonirrigated cropland.

10. Pilot Rock

Moderately deep, well drained soils that formed in loess overlying cemented alluvium; on fan terraces

This unit has slopes of 1 to 40 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 1,100 to 2,100 feet. The mean annual precipitation is 12 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 140 to 165 days.

This unit makes up about 3 percent of the survey area. It is about 70 percent Pilot Rock soils. Of minor extent are Entic Durochrepts, shallow soils overlying cemented gravelly alluvium, deep McKay soils on alluvial fans, moderately deep Anderly soils, and deep Walla Walla soils on hills.

The Pilot Rock soils have a surface layer and subsoil of silt loam over a hardpan.

Most of the area within this unit is used for small grain-fallow cropping. Some areas are used for irrigated crops such as alfalfa hay and small grain.

This unit is limited mainly by depth to a hardpan, low rainfall in areas of nonirrigated cropland, and the hazard of water erosion in the steeper areas.

11. McKay

Deep, well drained soils that formed in loess overlying old alluvium; on fan piedmonts

This unit has slopes of 0 to 5 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 1,450 to 1,900 feet. The mean annual precipitation is 14 to 18 inches, the mean annual air temperature is 48 to 52 degrees F, and the frost-free period is 140 to 160 days.

This unit makes up about 1 percent of the survey area. It is 95 percent McKay soils. Of minor extent are the Hermiston and Veazie soils on flood plains.

The McKay soils have a surface layer of silt loam. The subsoil is silty clay loam, and the substratum is gravelly silt loam and gravelly loam.

Nearly all of this unit is used for small grain-fallow cropping.

This unit is limited mainly by a slowly permeable subsoil, low rainfall in areas of nonirrigated cropland, and the hazard of water erosion.

Soils that formed in loess, colluvium, and alluvium on hills

This group consists of two map units. It makes up about 10 percent of the survey area.

12. Condon-Lickskillet

Moderately deep and shallow, well drained soils that formed in loess and colluvium; on ridges and hillslopes

This unit has slopes of 1 to 70 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 1,100 to 2,400 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 47 to 52 degrees F, and the frost-free period is 125 to 165 days.

This unit makes up about 4 percent of the survey area. It is about 55 percent Condon soils and 18 percent Lickskillet soils. Of minor extent are the very shallow Bakeoven and Condon soils on ridges, the deep Nansene and Cantala soils, and Kimberly soils on flood plains.

The Condon soils are moderately deep. They formed in loess on ridges. The surface layer and subsoil are silt loam over basalt.

The Lickskillet soils are shallow. They formed in loess and colluvium on hillslopes. The surface layer is very stony loam. The subsoil is very gravelly loam over basalt.

Most of this unit is used for small grain-fallow cropping and as rangeland.

The main limitations are depth to bedrock, steepness of slope in some areas, low rainfall in areas of nonirrigated cropland, and the hazard of water erosion.

13. Morrow-Lickskillet

Moderately deep and shallow, well drained soils that formed in loess, colluvium, and alluvium; on ridges and hillslopes

This unit has slopes of 1 to 70 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 2,000 to 3,100 feet. The mean annual precipitation is 13 to 16 inches, the mean annual air temperature is 46 to 50 degrees F, and the frost-free period is 110 to 150 days.

This unit makes up about 6 percent of the survey area. It is about 60 percent Morrow soils and 17 percent Lickskillet soils. Of minor extent are the very shallow Bakeoven and Morrow soils on ridges, the deep Cantala soils, the moderately deep Wrentham soils, the deep Rugg soils on terraces, and the deep Hermiston soils on flood plains.

The Morrow soils are moderately deep. They formed in loess and old alluvium on ridges. The surface layer is silt loam, the subsoil is silty clay loam, and the substratum is silt loam and silty clay loam over basalt.

The Lickskillet soils are shallow. They formed in loess and colluvium on hillslopes. The surface layer is very

stony loam, and the subsoil is very gravelly loam over basalt.

Most of this unit is used for small grain-fallow cropping and as rangeland.

The main limitations are the depth to bedrock, steepness of slope in some areas, low rainfall for nonirrigated cropping, and the hazard of water erosion.

Soils that formed in loess, residuum, and colluvium on the foothills of the Blue Mountains

This group consists of four map units. It makes up about 20 percent of the survey area.

14. Athena

Deep, well drained soils that formed in loess; on hills

This unit has slopes of 1 to 12 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 1,500 to 2,300 feet. The mean annual precipitation is 15 to 20 inches, the mean annual air temperature is 48 to 52 degrees F, and the frost-free period is 130 to 190 days.

This unit makes up about 4 percent of the survey area. It is about 82 percent Athena soils. Of minor extent are the deep Mondovi and Pedigo soils on flood plains and the moderately deep Waha soils.

The Athena soils have a surface layer, subsoil, and substratum of silt loam.

Most of this unit is used for annual cropping of small grain and peas. A few areas are used for irrigated crops such as alfalfa hay, small grain, and row crops. The main limitation is the hazard of water erosion in the steeper areas.

15. Gwin-Gurdane-Rockly

Very shallow to moderately deep, well drained soils that formed in loess, residuum, and colluvium; on hills and ridges

This unit has slopes of 0 to 70 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 1,600 to 4,500 feet. The mean annual precipitation is 16 to 25 inches, the mean annual air temperature is 45 to 49 degrees F, and the frost-free period is 100 to 150 days.

This unit makes up about 6 percent of the survey area. It is about 29 percent Gwin soils, 13 percent Gurdane soils, and 10 percent Rockly soils. Of minor extent are the shallow Gwinly soils, the deep Bowlus soils, the moderately deep Buckcreek soils, Umatilla soils, and deep Kahler soils.

The Gwin soils are shallow. They formed in loess, residuum, and colluvium in areas on hillslopes. The surface layer is very cobbly silt loam, and the subsoil is very cobbly silty clay loam over basalt.

The Gurdane soils are moderately deep. They formed in loess and residuum on ridges and hills. The surface layer is silty clay loam. The subsoil is silty clay loam and very cobbly clay over basalt.

The Rockly soils are very shallow. They formed in loess and residuum on ridges. The surface layer and substratum are very cobbly loam over basalt.

Most of this unit is used as rangeland. A few areas are used for small grain-fallow cropping.

The main limitations are steepness of slope, depth to bedrock, rock fragment content, and the slow permeability of the subsoil.

16. Waha-Palouse-Gwin

Shallow to deep, well drained soils that formed in loess, residuum, and colluvium; on ridges and hills

This unit has slopes of 1 to 70 percent. The native vegetation in areas not cultivated is grasses, shrubs, forbs, and scattered deciduous and coniferous trees. Elevation is 1,600 to 3,700 feet. The mean annual precipitation is 18 to 25 inches, the mean annual air temperature is 46 to 51 degrees F, and the frost-free period is 115 to 160 days.

This unit makes up about 4 percent of the survey area. It is about 26 percent Waha soils, 20 percent Palouse soils, and 20 percent Gwin soils. Of minor extent are shallow Gwinly soils, Umatilla soils, deep Kahler and Bowlus soils, very shallow Rockly and Waha soils on ridgetops, and Veazie and Mondovi soils on flood plains (fig. 1).

The Waha soils are moderately deep. They formed in loess and residuum on ridges and hills. The surface layer is silty clay loam, and the subsoil is silty clay loam and gravelly silty clay loam over basalt.

The Palouse soils are deep. They formed in loess on hills. The surface layer and subsoil are silt loam.

The Gwin soils are shallow. They formed in loess, residuum, and colluvium on hillslopes. The surface layer is very cobbly silt loam. The subsoil is very cobbly silty clay loam over basalt.

This unit is used for annual cropping of small grain and peas and as rangeland.

The main limitations are steepness of slope, depth to bedrock, rock fragment content in some areas, and the hazard of water erosion.

17. Gurdane-Gwinly

Moderately deep and shallow, well drained soils that formed in loess, residuum, and colluvium; on ridges and hillslopes

This unit has slopes of 0 to 45 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs. Elevation is 1,600 to 4,500 feet. The mean annual precipitation is 16 to 25 inches, the mean annual air temperature is 45 to 49 degrees F, and the frost-free period is 100 to 130 days.

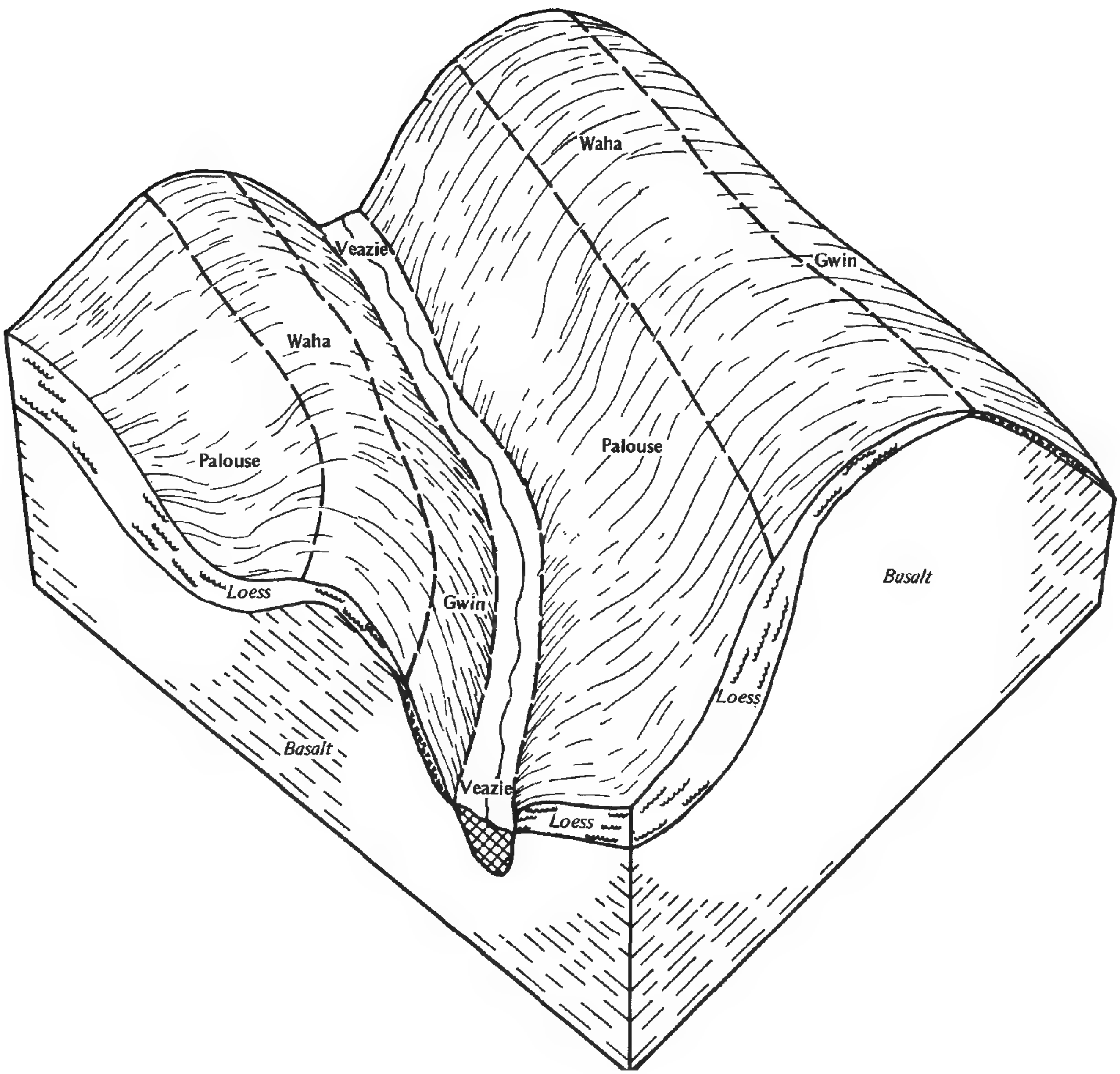


Figure 1.—Pattern of soils and parent material in general soil map unit 16.

This unit makes up about 6 percent of the survey area. It is about 48 percent Gurdane soils and 19 percent Gwinly soils. Of minor extent are the shallow Gwin soils, the moderately deep Buckcreek soils, the very shallow Rockly soils, and the deep Tutuilla soils in basins.

The Gurdane soils are moderately deep. They formed in loess and residuum on ridges and hillslopes. The

surface layer is silty clay loam, and the subsoil is silty clay loam and very cobbly clay over basalt.

The Gwinly soils are shallow. They formed in loess, residuum, and colluvium in steep areas on hillslopes. The surface layer is very cobbly silt loam, and the subsoil is very cobbly silty clay loam and clay over basalt.

Most of this unit is used for small grain-fallow cropping and as rangeland.

The main limitations are the depth to bedrock, the slow permeability of the subsoil, steepness of slope in some areas, and the hazard of water erosion.

Soils that formed in loess, volcanic ash, and residuum on plateaus and hills of the Blue Mountains

This group consists of three map units. It makes up about 13 percent of the survey area.

18. Cowsly-Thatuna

Deep, moderately well drained soils that formed in loess and residuum; on plateaus

This unit has slopes of 1 to 20 percent. The native vegetation in areas not cultivated is grasses, shrubs, and forbs and an overstory of coniferous trees. Elevation is 2,400 to 4,000 feet. The mean annual precipitation is 18 to 30 inches, the mean annual air temperature is 42 to 48 degrees F, and the frost-free period is 60 to 130 days.

This unit makes up about 1 percent of the survey area. It is about 45 percent Cowsly soils and 18 percent Thatuna soils. Of minor extent are the shallow Gwin soils and the deep Umatilla and Kahler soils.

The Cowsly soils have a surface layer of silt loam, a subsoil of silty clay loam, and a buried subsoil of silty clay.

The Thatuna soils have a surface layer of silt loam and a buried subsoil of silty clay loam.

Most of this unit is used for annual cropping of small grain and peas. Some areas are used for hay and pasture. A few areas are used for timber production.

This unit is limited by a perched water table in spring, slow permeability of the subsoil, and the hazard of water erosion.

19. Tolo-Klicker

Deep and moderately deep, well drained soils that formed in volcanic ash, loess, and residuum; on plateaus and hillslopes

This unit has slopes of 2 to 40 percent slopes. The native vegetation is grasses, shrubs, and forbs with an overstory of coniferous trees. Elevation is 3,000 to 5,000 feet. The mean annual precipitation is 17 to 45 inches, the mean annual air temperature is 40 to 45 degrees F, and the frost-free period is 30 to 100 days.

This unit makes up about 7 percent of the survey area. It is about 62 percent Tolo soils and 12 percent Klicker soils. Of minor extent are the moderately deep Albee soils, the shallow Anatone soils, the very shallow Bocker soils, the deep Umatilla and Kahler soils, the deep, moderately well drained Cowsly soils, and Helter soils.

The Tolo soils are deep. They formed in volcanic ash over a buried soil. The surface layer, subsoil, and buried subsoil are silt loam.

The Klicker soils are moderately deep. They formed in loess and residuum. The surface layer is silt loam and very stony silt loam, and the subsoil is very cobbly silty clay loam over basalt.

Most of this unit is used for timber production and livestock grazing.

This unit is limited by the hazards of soil compaction, soil displacement, and water erosion. In addition, the Klicker soils are limited by depth to bedrock and rock fragment content.

20. Anatone-Klicker-Tolo

Shallow to deep, well drained soils that formed in loess, residuum, and volcanic ash; on plateaus and hillslopes

This unit has slopes of 2 to 40 percent. The native vegetation is grasses, shrubs, and forbs. The Klicker soils have an overstory of coniferous trees. Elevation is 3,000 to 5,000 feet. The mean annual precipitation is 17 to 30 inches, the mean annual air temperature is 40 to 45 degrees F, and the frost-free period is 30 to 100 days.

This unit makes up about 5 percent of the survey area. It is about 30 percent Anatone soils, 26 percent Klicker soils, and 16 percent Tolo soils. Of minor extent are the moderately deep Albee soils, the deep Hankins soils on terraces, and the Umatilla and Kahler soils.

The Anatone soils are shallow. They formed in loess and residuum. The surface layer is very cobbly silt loam, and the subsoil is extremely cobbly loam over basalt.

The Klicker soils are moderately deep. They formed in loess and residuum. The surface layer is silt loam and very stony silt loam, and the subsoil is very cobbly silty clay loam over basalt.

The Tolo soils are deep. They formed in volcanic ash over a buried soil. The surface layer, subsoil, and buried subsoil are silt loam.

Most of this unit is used for livestock grazing. A few areas are used for timber production.

This unit is limited by the hazards of soil compaction and water erosion. In addition, the Anatone and Klicker soils are limited by depth to bedrock and rock fragment content.

Soils that formed in loess and tuffaceous sediment on terraces of the Blue Mountains

This group consists of one map unit. It makes up about 3 percent of the survey area.

21. Bridgecreek-Hankins

Moderately deep and deep, well drained soils that formed in loess overlying tuffaceous sediment; on terraces

This unit has slopes of 1 to 35 percent. The native vegetation is grasses, shrubs, and forbs. The Hankins soils have an overstory of coniferous trees. Elevation is 3,300 to 4,300 feet. The mean annual precipitation is 15 to 25 inches, the mean annual air temperature is 40 to 45 degrees F, and the frost-free period is 50 to 100 days.

This unit makes up about 3 percent of the survey area. It is about 50 percent Bridgecreek soils and 20 percent Hankins soils. Of minor extent are the poorly drained and moderately well drained Silvies and Winom soils in basins, the moderately deep Klicker soils, the deep Tolo soils, and the very shallow Bocker soils.

The Bridgecreek soils are moderately deep. The surface layer is silt loam, the subsoil is silty clay loam over clay, and the substratum is tuffaceous sediment.

The Hankins soils are deep. The surface layer is silt loam, the subsoil is silty clay loam over clay, and the substratum is clay loam over tuffaceous sediment.

Most of this unit is used as rangeland. A few areas are used for timber production. This unit is limited mainly by the slow permeability of the subsoil and substratum and the hazards of soil displacement, soil compaction, and water erosion.

Soils that formed in loess, colluvium, and residuum on hills of the Blue Mountains

This group consists of one map unit. It makes up about 9 percent of the survey area.

22. Gwin-Umatilla-Kahler

Shallow and deep, well drained soils that formed in colluvium, residuum, and loess; on hillslopes

This unit has slopes of 35 to 70 percent. The native vegetation is grasses, shrubs, and forbs with an overstory of coniferous trees. Elevation is 2,000 to 5,000 feet. The mean annual precipitation is 15 to 45 inches, the mean annual air temperature is 40 to 47 degrees F, and the frost-free period is 30 to 120 days.

This unit makes up about 9 percent of the survey area. It is about 35 percent Gwin soils, 18 percent Umatilla soils, and 10 percent Kahler soils. Of minor extent are the moderately deep Klicker and Buckcreek soils, the deep Tolo soils, and Xerofluvents on flood plains.

The Gwin soils are shallow. They formed in colluvium, residuum, and loess on south-facing slopes. The surface layer is very cobbly silt loam, and the subsoil is very cobbly silty clay loam over basalt.

The Umatilla soils are deep. They formed in colluvium and loess on north-facing slopes. The surface layer is loam, and the subsoil is very cobbly clay loam.

The Kahler soils are deep. They formed in colluvium and loess on north-facing slopes. The surface layer is silt loam, and the subsoil is silty clay loam and cobbly silty clay loam.

Most of this unit is used for timber production and as rangeland.

The main limitations are the steepness of slope, depth to bedrock, rock fragment content, and the hazards of soil displacement, soil compaction, and water erosion.

Broad Land Use Considerations

The general soil map units can be roughly divided according to several agricultural uses. These include irrigated cropping, small grain-fallow cropping, annual cropping, rangeland, and woodland (fig. 2).

The main limitations for agricultural uses are low rainfall in areas of nonirrigated cropland, depth to bedrock or a cemented pan, hazard of flooding, droughtiness, hazard of soil blowing, hazard of water erosion, and steepness of slope. Nearly half of the survey area is used for cultivated crops. The rest is mainly rangeland and woodland. Only a small part of the survey area is used for urban development. Much of the survey area has good potential for many different kinds of wildlife habitat and recreational uses.

The sandy soils in general soil map units 3, 4, and 5 generally are not suited to nonirrigated cropping because of low available water capacity and low rainfall. Units 4 and 5 make up about 8 percent of the survey area. They are limited for irrigated cropping by low natural fertility, low available water capacity, rapid permeability, and a high hazard of soil blowing. Because of the high water intake rate of the soils in these units, they commonly are irrigated by center pivot systems.

Most of the soils of the Columbia Plateau that are irrigated, such as those in general soil map units 1 and 2, are on flood plains. The soils in these units have contrasting uses and limitations. In unit 1, the Powder and Pedigo soils occur in the Echo Meadow area and along the Umatilla River and Butter Creek flood plains. The Pedigo soils are limited by a seasonal high water table and high content of sodium. They are used for hay and pasture. The Powder soils have few limitations and are used for irrigated crops.

In map unit 2, the Freewater soils in the Milton-Freewater area are used for fruit tree orchards. These soils are limited by a large number of rock fragments on the surface and in the soil, rapid permeability, and low available water capacity. The cobbles on the surface of the Freewater soils interfere with normal tillage operations. The Hermiston soils and Xerofluvents in unit 2 are on flood plains throughout the survey area. The Hermiston soils have few limitations and are used for irrigated crops. The Xerofluvents are frequently flooded and are limited for development.

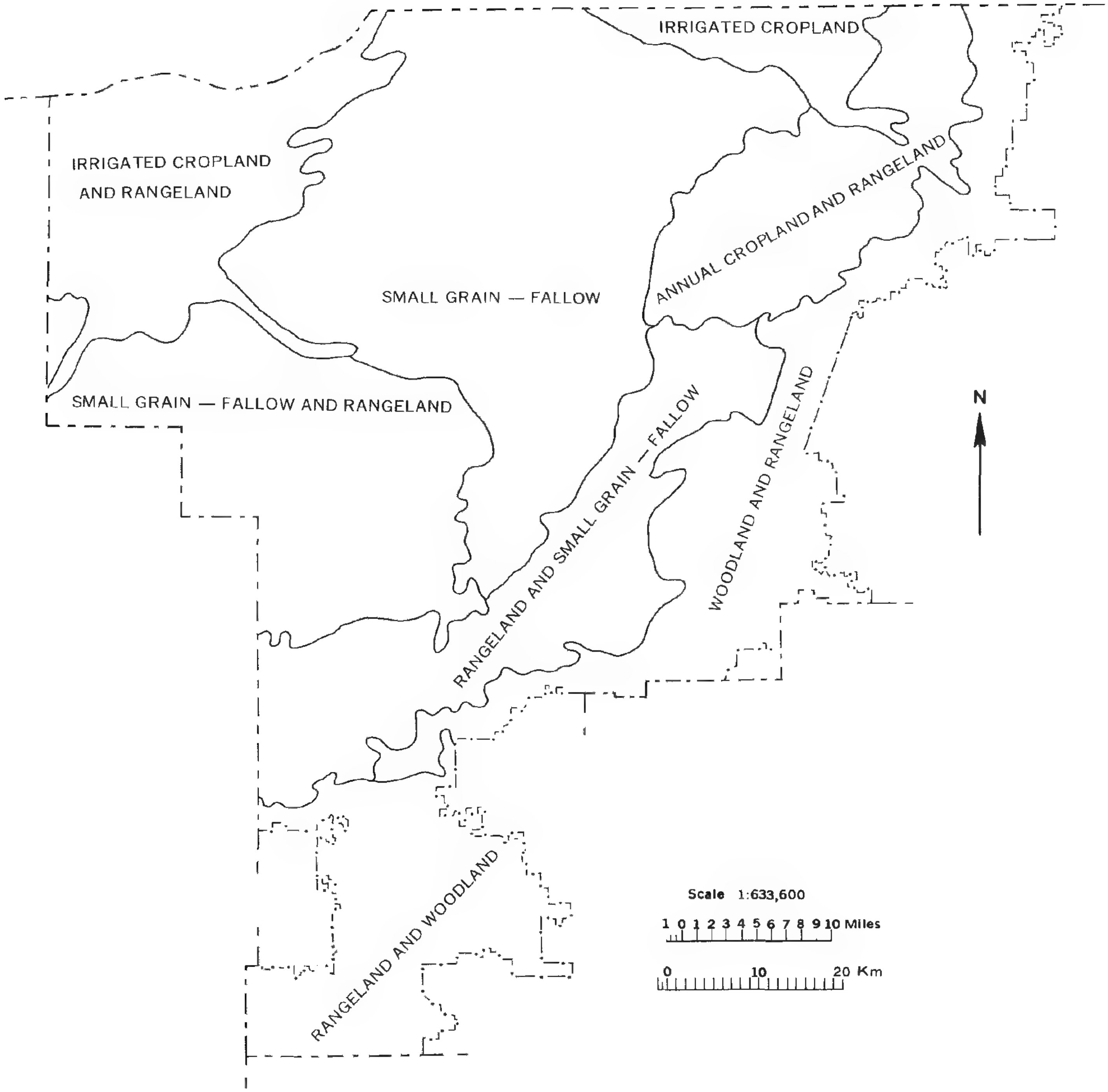


Figure 2.—Map of broad land uses of the survey area.

Unit 8 is on old terraces above the flood plain in the Milton-Freewater area. This unit is used for irrigated crops and has few limitations for this use.

Most small grain-fallow cropping is conducted in map units 6, 7, 8, 9, 10, 11, 12, and 13, on the Columbia Plateau. The highest yields are obtained in the deep

loess area north of Pendleton. The largest of the map units in this area is unit 9, which makes up about 13 percent of the survey area. Units 12 and 13 include rangeland soils on steep, south-facing hillsides. Because of low rainfall, a small grain-fallow cropping system is used on the Columbia Plateau to conserve soil moisture. Water erosion is a hazard on most of the soils on the Columbia Plateau.

Annual cropping is practiced in general map units 14, 16, and 18, in the northeastern part of the survey area and on the foothills of the Blue Mountains. Unit 14 is annually cropped and has few limitations. Even under nonirrigated conditions, this unit can be as productive as many of the soils that are irrigated in the survey area. Other areas used for annual cropping include units 16 and 18. Unit 16 is an area of steep slopes, where depth of loess varies with aspect. The soils in unit 18 have a perched water table in spring and a slowly permeable subsoil.

Map units 15 and 17, which are in the foothills of the Blue Mountains, are predominantly rangeland. Both of these units are limited for agricultural use by depth to bedrock, rock fragment content, slowly permeable subsoil, and steepness of slope.

General soil map units 19, 20, 21, and 22 include deep soils that receive sufficient rainfall to support coniferous trees. About 15 percent of the survey area supports commercial woodland; some of the potentially most productive timbered soils are in the Tollgate and Meacham areas. Unit 19 is used primarily for timber production, but some areas of woodland are grazed. The deep Tolo soils have few limitations and are among the more productive timbered soils in the Blue Mountains. The moderately deep Klicker soils are limited by restricted soil depth and rock fragment content. Most timbered soils are susceptible to soil compaction and displacement by harvesting equipment. Water erosion is a hazard in areas where the plant cover has been removed.

General soil map units 20 and 21 are predominantly rangeland. These units are in the Ukiah area. The Anatone soils in unit 20 are shallow rangeland soils. The Bridgecreek soils are moderately deep rangeland soils that are limited by a slowly permeable subsoil. The Hankins soils are forested and are limited by a slowly permeable subsoil and substratum.

In general soil map unit 22, the deep Umatilla and Kahler soils are forested and are on north-facing hillsides. The shallow Gwin soils are used as rangeland and are on south-facing hillsides. Unit 22 is limited by steepness of slope and depth to bedrock.

Less than 0.25 percent of the survey area is classified as urban or built-up land, most of which is in the Hermiston, Pendleton, and Milton-Freewater areas. Many of the limitations for urban development are similar to those for agricultural use. Agricultural soils do not always make the best foundation material or fill for embankments, dikes, and levees. Foundation strength, slippage, frost action, seepage, and piping limitations apply on most of the soils. Detailed mapping should be used to determine the specific limitations within an area. Many of these limitations can be overcome by design.

The sandy soils in the Columbia Basin are limited by a hazard of soil blowing, seepage, and piping. The loess soils on the Columbia Plateau generally have low strength for foundation and roadfill material, high frost action potential, and seepage and piping limitations. Because of slope, many soils in the Columbia Basin and Plateau areas are limited for urban development.

Generally, the soils on the foothills of the Blue Mountains and on the Blue Mountains are limited for urban development by steepness of slope, low strength, and moderate to high shrink-swell potential.

Recreational development on the soils in the survey area is limited by many of the same restrictive features as those that limit agricultural and urban development. Recreational activities such as hunting are related to the suitability of the soils as habitat for woodland, rangeland, and wetland wildlife.

The potential native plant community determines the wildlife habitat suitability rating. The droughty soils of the Columbia Basin have fair to poor suitability for rangeland wildlife habitat. Generally, the rangeland habitat on the soils of the Columbia Plateau and the foothills of the Blue Mountains is good. Grazeable woodland areas of the Blue Mountains have good suitability for rangeland and woodland habitat. Soils that have a seasonal high water table generally have fair suitability for wetland habitat.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit is given under "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavior divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation to precisely define and locate the soils and miscellaneous areas is needed.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Walla Walla silt loam, 1 to 7 percent slopes, is one of several phases in the Walla Walla series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or associations.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Condon-Bakeoven complex, 2 to 20 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary

to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Tolo-Klicker association, 3 to 15 percent slopes, is an example.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

1B—Adkins fine sandy loam, 0 to 5 percent slopes. This deep, well drained soil is on strath terraces of the Columbia River. It formed in eolian sand. Elevation is 250 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown fine sandy loam about 4 inches thick. The subsoil is pale brown fine sandy loam about 8 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and pale brown fine sandy loam.

Included in this unit are small areas of Adkins, gravelly substratum, soils; Adkins, wet, soils; and Quincy and Taunton soils. Also included are small areas of soils that are similar to this Adkins soil but have a substratum of loamy fine sand below a depth of 40 inches and Adkins soils that have slopes of 5 to 20 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Adkins soil is moderate. Available water capacity is about 8 to 11 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most areas of this unit are used for irrigated crops such as Irish potatoes, small grain, corn for grain and silage, and alfalfa hay. Among the other crops grown are mint, watermelons, and asparagus. Some areas are used for nonirrigated small grain, pasture, homesite development, rangeland, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility and the moderate hazard of soil blowing.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion (fig. 3).

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and Peking cotoneaster.

If this unit is used for nonirrigated crops, the main limitations are the moderate hazard of soil blowing and low rainfall. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control soil blowing. Other practices that can be used to control soil blowing and conserve moisture include seeding early in fall, performing minimum tillage, and stripcropping.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist can result in compaction of the surface layer, poor tilth, or excessive erosion.

Border, corrugation, and sprinkler irrigation systems are suited to this unit. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when

Figure 3.—Lined irrigation ditches reduce seepage and water loss on Adkins fine sandy loam, 0 to 5 percent slopes.

dry, grazing should be done when the soil is moist to minimize soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds

and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall and the moderate hazard of soil blowing.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes.

1C—Adkins fine sandy loam, 5 to 25 percent slopes. This deep, well drained soil is on strath terrace scarps of the Columbia River. It formed in eolian sand. Elevation is 250 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown fine sandy loam about 4 inches thick. The subsoil is pale brown fine sandy loam about 8 inches thick. The substratum to a depth of 60 inches or more is light brownish gray and pale brown fine sandy loam.

Included in this unit are small areas of Adkins, gravelly substratum, soils and Quincy and Taunton soils. Also included are small areas of soils that are similar to this Adkins soil but have a substratum of loamy fine sand below a depth of 40 inches and Adkins soils that have slopes of 25 to 40 percent or 0 to 5 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Adkins soil is moderate. Available water capacity is about 8 to 11 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for irrigated crops such as Irish potatoes, small grain, corn for grain and silage, and alfalfa hay. Among the other crops grown is nonirrigated small grain. Some areas are used for pasture, homesite development, rangeland, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, the moderate hazard of soil blowing, and slope. Because of slope, sprinkler or drip irrigation is the most suitable method of applying water. Center pivot irrigation systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion. Because of the risk of excessive runoff, it is important to carefully manage irrigation water in the more steeply sloping areas of this unit.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and Peking cotoneaster.

If this unit is used for nonirrigated crops, the main limitations are the moderate hazard of soil blowing and low rainfall. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control soil blowing. Other practices that can be used to control soil blowing and conserve moisture include seeding early in fall, performing minimum tillage, and stripcropping.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Because of slope, sprinkler irrigation systems are suited to this unit. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant

community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to minimize soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing, slope, and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall, the moderate hazard of soil blowing, and slope.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed.

Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes.

2B—Adkins fine sandy loam, gravelly substratum, 0 to 5 percent slopes. This deep, well drained soil is on strath terraces of the Columbia River. It formed in gravelly alluvial deposits mantled by eolian sand. Elevation is 250 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown fine sandy loam about 4 inches thick. The subsoil is brown fine sandy loam about 15 inches thick. The upper 26 inches of the substratum is brown fine sandy loam, and the lower part to a depth of 60 inches or more is grayish brown very gravelly fine sandy loam.

Included in this unit are small areas of Adkins soils that do not have a gravelly substratum and Burbank, Quincy, and Taunton soils. Also included are small areas of Adkins soils that have slopes of 5 to 25 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Adkins soil is moderately rapid. Available water capacity is about 6 to 9 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used mainly for irrigated crops such as Irish potatoes, small grain, alfalfa hay, and corn for grain and silage. It is also used for pasture, homesite development, rangeland, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, and the moderate hazard of soil blowing.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are ponderosa pine, Rocky Mountain juniper, and Siberian peashrub.

If this unit is used for nonirrigated crops, the main limitations are the moderate hazard of soil blowing and low rainfall. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control soil blowing. Other practices that can be used to control soil blowing and conserve moisture include seeding early in fall, performing minimum tillage, and stripcropping.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Border, corrugation, and sprinkler irrigation systems are suited to this unit. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall, the moderate hazard of soil blowing, and the high content of rock fragments and the moderately rapid permeability in the substratum.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

It is difficult to establish plants in areas where the upper part of the soil has been removed, exposing the gravelly substratum. Mulching and fertilizing cut areas help to establish plants. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability.

2C—Adkins fine sandy loam, gravelly substratum, 5 to 25 percent slopes. This deep, well drained soil is on strath terrace scarps of the Columbia River. It formed in gravelly alluvial deposits mantled by eolian sand. Elevation is 250 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown fine sandy loam about 4 inches thick. The subsoil is brown fine sandy loam about 15 inches thick. The upper 26 inches of the substratum is brown fine sandy loam, and the lower part to a depth of 60 inches or more is grayish brown very gravelly fine sandy loam.

Included in this unit are small areas of Adkins soils that do not have a gravelly substratum and Quincy and Taunton soils. Also included are small areas of Adkins soils that have slopes of 0 to 5 percent or 25 to 40 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Adkins soil is moderately rapid. Available water capacity is about 6 to 9 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used mainly for irrigated crops such as Irish potatoes, small grain, alfalfa hay, and corn for grain and silage. It is also used for pasture, homesite development, rangeland, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, the moderate hazard of soil blowing, and slope.

Because of slope, sprinkler or drip irrigation is the most suitable method of applying water. Center pivot

irrigation systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion. Because of the risk of excessive runoff, it is important to carefully manage irrigation water in the more steeply sloping areas of this unit.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are ponderosa pine, Rocky Mountain juniper, and Siberian peashrub.

If this unit is used for nonirrigated crops, the main limitations are the moderate hazard of soil blowing and low rainfall. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control soil blowing. Other practices that can be used to control soil blowing and conserve moisture include seeding early in fall, performing minimum tillage, and stripcropping.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Because of slope, sprinkler irrigation systems are suited to this unit. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing, slope, and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall, the moderate hazard of soil blowing, slope, and the high content of rock fragments and the moderately rapid permeability of the substratum.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed.

Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

It is difficult to establish plants in areas where the upper part of the soil has been removed, exposing the gravelly substratum. Mulching and fertilizing cut areas help to establish plants. In summer, irrigation is needed

for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability.

3A—Adkins fine sandy loam, wet, 0 to 3 percent slopes. This deep, well drained soil is in depressional areas on strath terraces of the Columbia River. It formed in eolian sand. The wetness is caused by canal seepage and irrigation. Elevation is 400 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown and pale brown fine sandy loam about 12 inches thick. The subsoil is pale brown fine sandy loam about 14 inches thick. The upper 24 inches of the substratum is light brownish gray fine sandy loam, and the lower part to a depth of 60 inches or more is greenish gray fine sandy loam. In some areas bedrock or sand and gravel are at a depth of 40 to 60 inches.

Included in this unit are small areas of Quincy, Starbuck, and Wanser soils. Also included are small areas of soils that are similar to this Adkins soil but have bedrock or sand and gravel at a depth of 20 to 40 inches and small areas of Adkins, wet, soils that have slopes of 3 to 15 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Adkins, wet, soil is moderately rapid. Available water capacity is about 8 to 10 inches. Effective rooting depth is 40 to 60 inches for water-tolerant plants but is limited to depths between 6 and 40 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. A seasonal high water table is at a depth of 18 to 42 inches in April through October, which is caused by canal seepage and irrigation.

Most areas of this unit are used for irrigated hay and pasture. Among the other crops grown are small grain, corn for grain and silage, and mint. Some areas are used for homesite or urban development and wildlife habitat.

If this unit is used for hay and pasture, the main limitations are wetness, the moderate hazard of soil blowing, and, in some areas, excess sodium.

This unit is below irrigation canals and has become wet from canal seepage and irrigation. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricting grazing to the drier areas of this unit help to keep the pasture in good condition and to protect the soil from erosion. Grazing those areas that are very wet may result in compaction of the surface layer, poor tilth, and excessive erosion.

The soil in this unit has a water table during the growing season and is subirrigated in most areas; however, if supplemental irrigation is necessary, sprinkler systems are suitable. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating, raising the water table, and leaching plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If gravity irrigation systems are used, water should be applied at frequent intervals and runs should be short. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

In some areas the concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the water table. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting. Subsurface or open drains can be used to remove excess water and provide an outlet for leached salts. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

Most climatically adapted crops can be grown if artificial drainage is provided and the excess salts are eliminated. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or corn. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Soil blowing generally is not a problem when the soil in this unit is in permanent pasture; however, when the plant cover is removed by tillage or for other reasons, it is susceptible to blowing. Practices that can be used to minimize soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Russian-olive, Rocky mountain juniper, and Siberian peashrub.

Population growth has resulted in increased construction of homes on this unit. The main limitations are wetness and the moderate hazard of soil blowing.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control

soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

Plants that tolerate a seasonal high water table and droughtiness should be selected unless drainage and irrigation are provided. It is difficult to establish plants in areas where the surface layer has been removed. Mulching and fertilizing cut areas help to establish plants.

The water table increases the possibility of failure of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

If this unit is used as building sites, drainage or special design may be needed to overcome the limitation imposed by the water table.

3C—Adkins fine sandy loam, wet, 3 to 15 percent slopes. This deep, well drained soil is in depressional areas on strath terraces of the Columbia River. It formed in eolian sand. The wetness is caused by canal seepage and irrigation. Elevation is 400 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown and pale brown fine sandy loam about 12 inches thick. The subsoil is pale brown fine sandy loam about 14 inches thick. The upper 24 inches of the substratum is light brownish gray fine sandy loam, and the lower part to a depth of 60 inches or more is greenish gray fine sandy loam. In some areas bedrock or sand and gravel are at a depth of 40 to 60 inches.

Included in this unit are small areas of Quincy and Wanser soils. Also included are small areas of soils that are similar to this Adkins soil but that have sand and gravel at a depth of 20 to 40 inches and small areas of Adkins, wet, soils that have slopes of 0 to 3 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Adkins soil is moderately rapid. Available water capacity is about 8 to 10 inches. Effective rooting depth is 40 to 60 inches for water-tolerant plants but is limited to depths between 6 and 40 inches for non-water-tolerant plants. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate. A seasonal high water table fluctuates between depths of 18 and 42 inches from April through October, which is caused by canal seepage and irrigation.

This unit is used mainly for irrigated hay and pasture. It is also used for homesite development.

This unit is suited to hay and pasture. The main limitations are wetness, the moderate hazard of soil blowing, slope, and, in some areas, excess sodium.

This unit is below irrigation canals and has become wet from canal seepage and irrigation. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricting grazing to the drier areas of this unit help to keep the pasture in good condition and to protect the soil from erosion. Grazing those areas that are very wet may result in compaction of the surface layer, poor tilth, and excessive erosion.

The soil in this unit has a water table during the growing season and is subirrigated in most areas. Because of the slope, sprinkler systems are suitable if supplemental irrigation is necessary. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating, raising the water table, and leaching plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

To reduce excessive runoff and erosion because of slope, water must be applied carefully when using gravity irrigation systems such as flood, border, or corrugation. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

In some areas the concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the water table. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting. Tile or open drains can be used to remove excess water and provide an outlet for leached salts. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

Most climatically adapted crops can be grown if artificial drainage is provided. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or corn. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Soil blowing generally is not a problem when the soil in this unit is in permanent pasture; however, when the plant cover is removed by tillage or for other reasons, it is susceptible to blowing. Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. Among the trees and shrubs that are suitable for windbreaks are Russian-olive, Rocky Mountain juniper, and Siberian peashrub.

Population growth has resulted in increased construction of homes on this unit. The main limitations are wetness, slope, and the moderate hazard of soil blowing.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing. Water erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed.

The water table increases the possibility of failure of septic tank absorption fields. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

If this unit is used as building sites, drainage or special design may be needed to overcome the limitation imposed by the water table.

4B—Adkins-Urban land complex, 0 to 5 percent slopes. This map unit is on strath terraces of the Columbia River. Elevation is 400 to 500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is 55 percent Adkins fine sandy loam and 25 percent Urban land.

Included in this unit are small areas of Adkins, wet, soils and Quincy, Wanser, and Winchester soils. Included areas make up about 20 percent of the total acreage.

The Adkins soil is deep and well drained. It formed in eolian sand. Typically, the surface layer is brown fine sandy loam about 4 inches thick. The subsoil is pale brown fine sandy loam about 8 inches thick. The substratum to a depth of 60 inches or more is pale brown and light brownish gray fine sandy loam. Depth to basalt is 60 inches or more.

Permeability of this Adkins soil is moderate. Available water capacity is about 8 to 11 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

This unit is used for urban and homesite development. Population growth has resulted in increased construction of homes on this unit. The main limitations are the moderate hazard of soil blowing and low rainfall.

Excavation for houses and access roads exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Plant cover can be established and maintained through proper fertilization, seeding, mulching, and shaping of slopes.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This unit is well suited to windbreaks and environmental plantings. The main limitations are low rainfall and the moderate hazard of soil blowing. Establishment of tree seedlings may be difficult because of these limitations. Supplemental irrigation may be needed when planting and during dry periods. If irrigation is used, most climatically adapted shrubs and trees can be grown. Among the trees that are suitable for planting are Russian-olive, green ash, and Rocky Mountain juniper. Among the shrubs is Siberian peashrub.

5C—Albee-Bocker-Anatone complex, 2 to 15 percent slopes. This map unit is on broad ridges. Elevation is 3,500 to 5,200 feet. The average annual precipitation is 17 to 35 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 110 days.

This unit is 40 percent Albee silt loam, 30 percent Bocker very cobbly silt loam, and 20 percent Anatone very cobbly silt loam. The percentage varies from one area to another. The soils occur as patterned land, locally known as biscuit-scabland. The Bocker and Anatone soils occur as scabland between and around areas of the Albee soil. The Albee soil is in the form of circular mounds, or biscuits, that have a convex surface and are deepest in the center.

Included in this unit are small areas of Kahler, Klicker, Tolo, and Umatilla soils. Also included are small areas of Albee, Anatone, and Bocker soils that have slopes of 15 to 30 percent. Included areas make up about 10 percent of the total acreage.

The Albee soil is moderately deep and well drained. It formed in residuum mixed with loess. Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown and yellowish brown silt loam about 18 inches thick. Basalt is at a depth of 28 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Albee soil is moderate. Available water capacity is about 4 to 6 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Bocker soil is very shallow and well drained. It formed in residuum mixed with loess. The surface layer is brown very cobbly silt loam about 4 inches thick. The subsoil is brown very cobbly silt loam about 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt

ranges from 4 to 10 inches. In some areas the surface layer is stony.

Permeability of the Bocker soil is moderate. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 4 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Anatone soil is shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is dark brown very cobbly silt loam about 5 inches thick. The subsoil is dark brown extremely cobbly loam about 7 inches thick. Basalt is at a depth of 12 inches. Depth to basalt ranges from 10 to 20 inches. In some areas the surface layer is stony.

Permeability of the Anatone soil is moderate. Available water capacity is about 1.0 inch to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

The potential plant community on the Albee soil is mainly Idaho fescue, bluebunch wheatgrass, and prairie junegrass. The potential plant community on the Bocker soil is mainly Sandberg bluegrass and bluebunch wheatgrass. The potential plant community on the Anatone soil is mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by the high content of rock fragments and shallow depth of the Anatone and Bocker soils.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding or other mechanical or chemical treatment is poor. The main limitation for treatment is the interspersed areas of the shallow Anatone and Bocker soils. The plants selected for seeding should meet the seasonal requirements for livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

6B—Anderly silt loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 13 inches thick. The subsoil is pale brown silt loam about 11 inches thick. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Lickskillet soils and Walla Walla soils, some of which have a hardpan at a depth of 40 to 60 inches. Also included are small areas of Anderly soils that have slopes of 7 to 12 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Anderly soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

6C—Anderly silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess. It is mainly on south- and west-facing slopes. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 13 inches thick. The subsoil is pale brown silt loam about 11 inches thick. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Lickskillet soils and Walla Walla soils, some of which have a hardpan at a depth of 40 to 60 inches. Also included are small areas of Anderly soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Anderly soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

6D—Anderly silt loam, 12 to 20 percent slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess. It is mainly on south- and west-facing slopes. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 13 inches thick. The subsoil is pale brown silt loam about 11 inches thick. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Lickskillet soils and Walla Walla soils, some of which have a hardpan at a depth of 40 to 60 inches. Also included are small areas of Anderly soils that have slopes of 1 to 12 percent or 20 to 35 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Anderly soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for nonirrigated small grain. It is also used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock, droughtiness, and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control

erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope and limited soil depth, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

6E—Anderly silt loam, 20 to 35 percent slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess. It is mainly on south- and west-facing slopes. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 13 inches thick. The subsoil is pale brown silt loam about 11 inches thick. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Lickskillet and Walla Walla soils and Rock outcrop. Also included are small areas of Anderly soils that have slopes of 12 to 20 percent or 35 to 50 percent and soils that are similar to this Anderly soil but have 15 to 50 percent rock fragments. Included areas make up about 25 percent of the total acreage.

Permeability of this Anderly soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

7C—Anderly-Urban land complex, 7 to 12 percent slopes. This map unit is on broad summits of hills. Elevation is 1,100 to 1,500 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 51 to 53 degrees F, and the average frost-free period is 160 to 170 days.

This unit is 60 percent Anderly silt loam and 30 percent Urban land.

Included in this unit are small areas of Lickskillet soils and Walla Walla soils, some of which have a hardpan at a depth of 40 to 60 inches. Also included are small areas of Anderly soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 10 percent of the total acreage.

The Anderly soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is brown silt loam about 13 inches thick. The subsoil is pale brown silt loam about 11 inches thick. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Permeability of the Anderly soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

If this unit is used for urban development, the main limitations are the moderate depth to bedrock and slope.

Cuts needed to provide essentially level building sites can expose bedrock. Erosion is a hazard in the steeper

areas. Only the part of the site that is used for construction should be disturbed. The risk of erosion is increased if the soil is left exposed during site development. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

The moderate depth to bedrock increases the possibility of failure of septic tank absorption fields. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

8B—Athena silt loam, 1 to 7 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 48 to 52 degrees F, and the average frost-free period is 130 to 190 days.

Typically, the surface layer is dark grayish brown silt loam about 15 inches thick. The subsurface layer is dark grayish brown silt loam about 11 inches thick. The upper part of the subsoil is brown and light yellowish brown silt loam about 20 inches thick, and the lower part to a depth of 60 inches or more is light yellowish brown silt loam. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Mondovi and Waha soils. Also included are small areas of Athena soils that have slopes of 7 to 12 percent. Included areas make up about 5 percent of the total acreage.

Permeability of this Athena soil is moderate. Available water capacity is about 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated crops. A few areas are used for irrigated crops such as small grain, alfalfa hay, and row crops. Some areas are used as rangeland.

This unit is suited to nonirrigated crops and is cropped annually using a small grain-pea rotation.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitations are the availability of irrigation water and the moderate hazard of erosion.

Sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and hawthorn.

8C—Athena silt loam, 7 to 12 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 48 to 52 degrees F, and the average frost-free period is 130 to 190 days.

Typically, the surface layer is dark grayish brown silt loam about 15 inches thick. The subsurface layer is dark grayish brown silt loam about 11 inches thick. The upper part of the subsoil is brown and light yellowish brown silt loam, and the lower part to a depth of 60 inches or more is light yellowish brown silt loam. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Waha soils. Also included are small areas of Athena soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Athena soil is moderate. Available water capacity is about 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for nonirrigated crops and is cropped annually using a small grain-pea rotation. Some areas are used as rangeland.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms

easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and hawthorn.

9C—Bocker very cobbly silt loam, 2 to 12 percent slopes. This very shallow, well drained soil is on ridges and plateaus of the Blue Mountains. It formed in residuum mixed with loess. Elevation is 3,500 to 5,100 feet. The average annual precipitation is 17 to 35 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 60 to 110 days.

Typically, the surface layer is brown very cobbly silt loam about 4 inches thick. The subsoil is brown very cobbly silt loam about 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 10 inches. In some areas the surface layer is stony.

Included in this unit are small areas of Albee, Anatone, and Klicker soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Bocker soil is moderate. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 4 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Sandberg bluegrass stiff sagebrush, and bluebunch wheatgrass. The production of forage is limited by the high content of rock fragments in the soil and the very shallow depth to bedrock.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system. Use of mechanical treatment practices generally is not practical because of the very shallow depth to bedrock and the high content of rock fragments in the soil.

10D—Bocker-Bridgecreek complex, 1 to 15 percent slopes. This map unit is on broad summits of hills. Elevation is 3,300 to 4,300 feet. The average annual precipitation is 17 to 25 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 45 percent Bocker very cobbly silt loam and 35 percent Bridgecreek silt loam. The percentage varies from one area to another. The soils occur as patterned land, locally known as biscuit-scabland. The Bocker soil occurs as scabland between and around the areas of the Bridgecreek soil. The Bridgecreek soil is in the form of circular mounds, or biscuits, that have a convex surface and are deepest in the center.

Included in this unit are small areas of Albee, Anatone, and Hankins soils. Also included are small areas of soils that are similar to the Bridgecreek soil but have more than 35 percent rock fragments. Included areas make up about 20 percent of the total acreage.

The Bocker soil is very shallow and well drained. It formed in residuum mixed with loess. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown very cobbly silt loam about 4 inches thick. The subsoil is brown very cobbly silt loam about 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 10 inches.

Permeability of the Bocker soil is moderate. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 4 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Bridgecreek soil is moderately deep and well drained. It formed in loess and tuffaceous sediment. Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The upper 6 inches of the subsoil is brown silt loam, the next 10 inches is brown and pale brown silty clay loam, and the lower part to a depth of 32 inches is dark brown clay. Tuff is at a depth of 32 inches. Depth to tuff ranges from 20 to 40 inches. In some areas basalt is at a depth of 20 to 40 inches.

Permeability of the Bridgecreek soil is very slow. Available water capacity is about 3.5 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Bocker soil is mainly Sandberg bluegrass, stiff sagebrush, and bluebunch wheatgrass. The potential plant community on the Bridgecreek soil is mainly Idaho fescue, bluebunch wheatgrass, and prairie junegrass. The production of forage is limited by the high content of rock fragments and the very shallow depth of the Bocker soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock

grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding or other mechanical or chemical treatment is poor. The main limitation for treatment is the interspersed areas of stony Bocker soil. The plants selected for seeding should meet the seasonal requirements for livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

11F—Bowlus-Buckcreek association, 40 to 70 percent slopes. This map unit is on hillslopes in the foothills of the Blue Mountains. Slopes are convex and generally are north- or east-facing. Elevation is 2,000 to 3,800 feet. The average annual precipitation is 20 to 30 inches, the average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 50 percent Bowlus silt loam and 25 percent Buckcreek silt loam. The percentage varies from one area to another.

Included in this unit are small areas of Gwin, Kahler, Umatilla, and Waha soils. Also included are small areas of Rock outcrop and Bowlus and Buckcreek soils that have slopes of less than 40 percent or more than 70 percent. Included areas make up about 25 percent of the total acreage.

The Bowlus soil is deep and well drained. It formed in loess and colluvium. It generally is in concave positions and on toe slopes. Typically, the surface layer is very dark gray and very dark grayish brown silt loam about 19 inches thick. The upper 23 inches of the subsoil is very dark grayish brown silt loam, and the lower 18 inches is yellowish brown very cobbly silty clay loam. In some areas depth to basalt ranges from 40 to 60 inches.

Permeability of the Bowlus soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Buckcreek soil is moderately deep and well drained. It formed in loess and colluvium. It generally is in convex positions. Typically, the surface layer is very dark gray silt loam about 11 inches thick. The upper 12 inches of the subsoil is very dark grayish brown cobbly silt loam, and the lower 13 inches is brown very cobbly silty clay loam. Basalt is at a depth of 36 inches. Depth to basalt ranges from 20 to 60 inches.

Permeability of the Buckcreek soil is moderate. Available water capacity is about 2.5 to 8.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for wildlife habitat and rangeland.

The potential plant community on the Bowlus soil is mainly Idaho fescue, hawthorn, and common snowberry. The potential plant community on the Buckcreek soil is mainly Idaho fescue, bluebunch wheatgrass, and common snowberry. The production of forage is limited by the large amount of woody shrubs present.

The soils in this unit support heavy plant cover and offer limited grazing for livestock. The inclusions of shallower soils on south- or west-facing slopes are less bushy and more likely to be used by livestock.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface is stony and the slopes are steep.

Steepness of slope and rock outcroppings limit access by livestock and promote overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock grazing in areas where access is limited.

12C—Bridgecreek silt loam, 1 to 12 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess and tuffaceous sediment. Elevation is 3,300 to 4,300 feet. The average annual precipitation is 15 to 25 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The upper 6 inches of the subsoil is brown silt loam, the next 10 inches is brown and pale brown silty clay loam, and the lower part to a depth of 32 inches is dark brown clay. Tuff is at a depth of 32 inches. Depth to tuff ranges from 20 to 40 inches. In some areas basalt is at a depth of 20 to 40 inches.

Included in this unit are small areas of Albee, Anatone, Bocker, and Hankins soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Bridgecreek soil is very slow. Available water capacity is about 3.5 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and prairie junegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less

preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is the very slow permeability. Because of the high clay content and very slow permeability of the soil in this unit, seeding with heavy equipment should be restricted to drier periods to reduce erosion, compaction, and rutting. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

12E—Bridgecreek silt loam, 12 to 35 percent slopes. This moderately deep, well drained soil is on terrace scarps. It formed in loess and tuffaceous sediment. It is mainly on south- and west-facing slopes. Elevation is 3,300 to 4,300 feet. The average annual precipitation is 15 to 25 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The upper 6 inches of the subsoil is brown silt loam, the next 10 inches is brown and pale brown silty clay loam, and the lower part to a depth of 32 inches is dark brown clay. Tuff is at a depth of 32 inches. Depth to tuff ranges from 20 to 40 inches. In some areas basalt is at a depth of 20 to 40 inches.

Included in this unit are small areas of Albee, Anatone, and Hankins soils. Also included are small areas of Bridgecreek soils that have slopes of 1 to 12 percent or 35 to 50 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Bridgecreek soil is very slow. Available water capacity is about 3.5 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and prairie junegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding is poor. The main limitations for seeding are the steepness of slope, the high clay content, and the very slow permeability. Seeding with heavy equipment should be restricted to the drier periods and to the more gently sloping areas to reduce erosion, compaction, and rutting. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

13F—Buckcreek-Gwin association, 45 to 70 percent slopes. This map unit is on hillslopes in the foothills of the Blue Mountains (fig. 4). Elevation is 2,000 to 4,200 feet. The average annual precipitation is 20 to 30 inches, the average annual air temperature is 41 to 47 degrees F, and the average frost-free period is 60 to 120 days.

This unit is 55 percent Buckcreek silt loam and 15 percent Gwin very cobbly silt loam.

Included in this unit are small areas of Bowlus, Kahler, Rockly, and Umatilla soils and small areas of moderately deep silty clay loam. Also included are small areas of Rock outcrop, soils that are similar to the Buckcreek soil but that have less than 35 percent rock fragments, and Buckcreek and Gwin soils that have slopes of 30 to 45 percent. Included areas make up about 30 percent of the total acreage.

The Buckcreek soil is moderately deep and well drained. It formed in loess and colluvium on north- and east-facing slopes. Typically, the surface layer is very dark gray silt loam about 11 inches thick. The upper 12 inches of the subsoil is very dark grayish brown cobbly silt loam, and the lower 13 inches is brown very cobbly silty clay loam. Basalt is at a depth of 36 inches. Depth to basalt ranges from 20 to 60 inches.

Permeability of the Buckcreek soil is moderate. Available water capacity is about 2.5 to 8.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Gwin soil is shallow and well drained. It formed in colluvium, residuum, and loess on south- and west-facing slopes. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is dark grayish brown extremely stony silt loam about 7 inches thick. The subsoil is brown very cobbly silty clay loam about 6 inches thick. Basalt is at a depth of 13 inches. Depth to basalt ranges from 10 to 30 inches.

Permeability of the Gwin soil is moderately slow. Available water capacity is about 1.5 to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Buckcreek soil is mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. The potential plant community on

Figure 4.—Typical area of Buckcreek-Gwin association, 45 to 70 percent slopes.

the Gwin soil is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the high content of rock fragments and shallow depth to bedrock in the Gwin soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface is stony and the slopes are steep.

Steepness of slope and rock outcroppings limit access by livestock and promote overgrazing of the less sloping areas. Trails or walkways can be constructed in some

areas to encourage livestock grazing in areas where access is limited.

14B—Burbank loamy fine sand, 0 to 5 percent slopes. This deep, excessively drained soil is on strath terraces of the Columbia River. It formed in gravelly alluvial deposits mantled by eolian sand. Elevation is 550 to 650 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown loamy fine sand about 6 inches thick. The upper 19 inches of the underlying material is brown loamy fine sand, the next 5 inches is light brownish gray very gravelly loamy fine sand, and the lower part to a depth of 60 inches or more is dark gray extremely gravelly sand.

Included in this unit are about 10 percent soils that are similar to this Burbank soil but have a fine sandy loam surface layer and 5 percent Quincy soils, most of which have a gravelly substratum.

Permeability of this Burbank soil is rapid to a depth of 30 inches and very rapid below this depth. Available water capacity is about 1.5 to 3.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Most areas of this unit are used for irrigated crops, mainly Irish potatoes, alfalfa hay, corn for grain and silage, and small grain. Some areas are used as rangeland and for pasture, wildlife habitat, and homesite development.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, very rapid permeability, and the high hazard of soil blowing.

Because the water intake rate is rapid, sprinkler or drip irrigation is best suited to this unit. Center pivot irrigation systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil is droughty, the applications of water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion and seepage.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth. Other practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and cultivating, planting, and conducting other farming practices at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown. Among the trees and shrubs that are suitable for windbreaks are Russian-olive, Rocky Mountain juniper, and honeysuckle.

If this unit is used for pasture, use of proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, and antelope bitterbrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if the soil in this unit is overgrazed. Because the soil is susceptible to displacement when dry, grazing should be done when the soil is moist to minimize soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the high hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, rotation grazing, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

If this unit is used for homesite development, the main limitations are low rainfall, the high hazard of soil blowing, low available water capacity, and the high content of coarse fragments in the soil.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil

blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. It is difficult to establish plants in areas where the surface layer has been removed, exposing the very gravelly underlying material. Mulching and fertilizing cut areas help to establish plants.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

15B—Burke silt loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess over cemented alluvium. Elevation is 650 to 1,300 feet. The average annual precipitation is about 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is pale brown coarse silt loam about 8 inches thick. The subsoil is pale brown coarse silt loam about 10 inches thick. The substratum is light gray silt loam 8 inches thick over a hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam or fine sandy loam.

Included in this unit are small areas of Shano soils and soils that have a hardpan at a depth of less than 20 inches or at a depth of 40 to 60 inches. Also included are small areas of Burke soils that have slopes of 7 to 20 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Burke soil is moderate to a depth of 26 inches and very slow below this depth. Available water capacity is about 4 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated small grain, rangeland, and wildlife habitat. A few areas are used for irrigated crops such as small grain, alfalfa hay, corn for grain and silage, and Irish potatoes.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to the hardpan and the moderate hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main cropland management needs are to minimize soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, it is limited mainly by the availability of irrigation water, the presence of a hardpan, and the moderate hazards to soil blowing and water erosion.

Sprinkler and drip irrigation systems are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of water erosion or developing a perched water table, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, stripcropping in nonirrigated areas, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and Tatarian honeysuckle.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The

production of forage is limited by low natural fertility and low rainfall.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

15C—Burke silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess over cemented alluvium. Elevation is 650 to 1,300 feet. The average annual precipitation is about 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is pale brown coarse silt loam about 8 inches thick. The subsoil is pale brown coarse silt loam about 10 inches thick. The substratum is light gray silt loam 8 inches thick over a hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam or fine sandy loam.

Included in this unit are small areas of Shano soils and soils that have a hardpan at a depth of less than 20 inches or at a depth of 40 to 60 inches. Also included are small areas of Burke soils that have slopes of 1 to 7 percent or 12 to 30 percent. Included areas make up about 25 percent of the total acreage.

Permeability of the Burke soil is moderate to a depth of 26 inches and very slow below this depth. Available water capacity is about 4 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated small grain, rangeland, and wildlife habitat. A few areas are used for irrigated crops such as small grain, alfalfa hay, corn for grain and silage, and Irish potatoes.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to the hardpan and the moderate hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low natural fertility and low rainfall.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for irrigated crops, it is limited mainly by the availability of irrigation water, the presence of a hardpan, and the moderate hazards of water erosion and soil blowing.

Sprinkler or drip irrigation is the most suitable method of applying water. Center pivot systems commonly are

used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid overirrigating and increasing the risk of water erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping in nonirrigated areas, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and Tatarian honeysuckle.

15E—Burke silt loam, 12 to 30 percent slopes. This moderately deep, well drained soil is on terrace scarps. It formed in loess over cemented alluvium. Elevation is 650 to 1,300 feet. The average annual precipitation is about 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is pale brown coarse silt loam about 8 inches thick. The subsoil is pale brown coarse silt loam about 10 inches thick. The substratum is light gray silt loam 8 inches thick over a hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam or fine sandy loam.

Included in this unit are small areas of Shano soils and soils that have a hardpan at a depth of less than 20 inches or at a depth of 40 to 60 inches. Also included are small areas of Burke soils that have slopes of 1 to 12 percent. Included areas make up about 25 percent of the total acreage.

Permeability of the Burke soil is moderate to a depth of 26 inches and very slow below this depth. Available water capacity is about 4 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used as rangeland, for nonirrigated small grain, and as wildlife habitat.

This unit is suited to nonirrigated crops. It is limited by the high hazard of water erosion, the moderate hazard of soil blowing, and slope. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Other practices that can be used to reduce soil blowing are establishing windbreaks; stripcropping, where feasible; keeping the soil rough and cloddy when it is not protected by plant cover; and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Scotch pine, and Tatarian honeysuckle.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. To reduce erosion and increase the conservation of soil moisture, leave more residue on the surface. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low natural fertility and low rainfall.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall, the moderate hazard of soil blowing, and slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is

managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may be limited in the steeper areas of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

16B—Cantala silt loam, 1 to 7 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess and old alluvium. Elevation is 1,100 to 3,100 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 16 inches thick. The subsoil is yellowish brown silt loam about 29 inches thick. The substratum to a depth of 60 inches or more is pale brown loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included in this unit are small areas of Condon, Lickskillet, and Morrow soils. Also included are small areas of Cantala soils that have slopes of 7 to 12 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Cantala soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

16C—Cantala silt loam, 7 to 12 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess and old alluvium. It is on north- and east-facing slopes. Elevation is 1,100 to 3,100 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 16 inches thick. The subsoil is yellowish brown silt loam about 29 inches thick. The substratum to a depth of 60 inches or more is brown loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included in this unit are small areas of Condon, Lickskillet, and Morrow soils. Also included are small areas of Cantala soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Cantala soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

16D—Cantala silt loam, 12 to 20 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess and old alluvium. It is on north- and east-facing slopes. Elevation is 1,100 to 3,100 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 16 inches thick. The subsoil is yellowish brown silt loam about 29 inches thick. The substratum to a depth of 60 inches or more is pale brown loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included in this unit are small areas of Condon, Lickskillet, and Morrow soils. Also included are small areas of Cantala soils that have slopes of 7 to 12 percent or 20 to 35 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Cantala soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for nonirrigated small grain and as rangeland.

This unit is suited to nonirrigated crops. It is limited mainly by the high hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

16E—Cantala silt loam, 20 to 35 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess and old alluvium. It is on north- and east-facing slopes. Elevation is 1,100 to 3,100 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 16 inches thick. The subsoil is yellowish brown silt loam about 29 inches thick. The substratum to a depth of 60 inches or more is pale brown loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included in this unit are small areas of Condon, Lickskillet, Morrow, and Wrentham soils. Also included are small areas of Rock outcrop and Cantala soils that have slopes of 12 to 20 percent or 35 to 50 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Cantala soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and for nonirrigated small grain.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices in some areas may not be practical because of the steepness of slope.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

If this unit is used for nonirrigated crops, the main limitations are slope and the high hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable; however, because of the steepness of slope and high hazard of erosion, the more steeply sloping areas of this unit should be planted to permanent vegetation.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

17A—Catherine Variant-Catherine silt loams, 0 to 3 percent slopes. This map unit is on flood plains. Elevation is 600 to 1,300 feet. The average annual precipitation is 11 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 155 to 195 days.

This unit is about 50 percent Catherine Variant silt loam and 25 percent Catherine silt loam. The percentage varies from one area to another.

Included in this unit are small areas of Hermiston, Pedigo, and Powder soils. Also included are small areas of soils that are similar to the Catherine Variant soils but that have gravel at a depth of less than 20 inches. Included areas make up about 25 percent of the total acreage.

The Catherine Variant soil is deep and poorly drained. It formed in mixed alluvium. Typically, the surface layer is dark grayish brown and grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 18 inches thick. The substratum to a depth of 60 inches or more is grayish brown and brown very gravelly silt loam. In some areas the surface layer is silty clay loam.

Permeability of the Catherine Variant soil is moderate. Available water capacity is about 8 to 12 inches. Effective rooting depth is 60 inches or more for water-tolerant plants but is limited to depths between 12 and 48 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 0 and 48 inches throughout the year. This soil is subject to brief periods of flooding in winter and spring.

The Catherine soil is deep and somewhat poorly drained. It formed in mixed alluvium. Typically, the surface layer is dark grayish brown and grayish brown silt loam about 22 inches thick. The subsoil is grayish brown silt loam about 3 inches thick. The upper 15 inches of the substratum is grayish brown silt loam, and the lower part to a depth of 60 inches or more is grayish brown gravelly silt loam.

Permeability of the Catherine soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more for water-tolerant plants but is limited to depths between 24 and 48 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 24 and 48 inches in winter and spring. This soil is subject to brief periods of flooding in winter and spring.

Most areas of this unit are used for pasture. A few areas are used for homesite development and as rangeland. The unit is limited mainly by wetness and the hazard of flooding.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricting grazing to the drier areas of this unit help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

This unit has a high water table during the growing season and is subirrigated in many areas; however, if supplemental irrigation is necessary, sprinkler systems generally are most suitable. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating, raising the water table, and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If gravity irrigation systems are used, leveling is needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

If this unit is used for homesite development, the main limitations are wetness and the hazard of flooding.

The water table increases the possibility of failure of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

If this unit is used as building sites, drainage or special design is needed to overcome the limitation imposed by the water table.

Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level.

The potential plant community on this unit is mainly tufted hairgrass, sedge, and Baltic rush.

18B—Condon silt loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,100 to 2,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and light yellowish brown silt loam about 22 inches thick. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Bakeoven and Lickskillet soils. Also included are small areas of Condon soils that have slopes of 7 to 12 percent and soils that are similar to this Condon soil but that have 15 to 50 percent rock fragments. Included areas make up about 15 percent of the total acreage.

Permeability of this Condon soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

18C—Condon silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,100 to 2,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and light yellowish brown silt loam about 22 inches thick. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Bakeoven, Cantala, and Lickskillet soils. Also included are small areas of Condon soils that have slopes of 1 to 7 percent or 12 to 20 percent and soils that are similar to this Condon soil but that have 15 to 50 percent rock fragments. Included areas make up about 25 percent of the total acreage.

Permeability of this Condon soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

18E—Condon silt loam, 20 to 35 percent slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess. It is mainly on north- and east-facing slopes. Elevation is 1,100 to 2,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and light yellowish brown silt loam about 22 inches thick. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Bakeoven, Cantala, and Lickskillet soils. Also included are small areas of Rock outcrop and Condon soils that have slopes of 12 to 20 percent or 40 to 50 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Condon soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper areas of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

If this unit is used for nonirrigated crops, the main limitations are moderate depth to bedrock, slope, and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping; however, because of the steepness of slope and high hazard of water erosion, the more steeply sloping areas of this unit should be planted to permanent vegetation.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

19D—Condon silt loam, 12 to 20 percent north slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess. Elevation is 1,100 to 2,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and light yellowish brown silt loam about 22 inches thick. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Bakeoven, Cantala, and Lickskillet soils. Also included are small areas of Condon soils that have slopes of 1 to 12 percent or 20 to 30 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Condon soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for nonirrigated small grain. It is also used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

20D—Condon silt loam, 12 to 20 percent south slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess. Elevation is 1,100 to 2,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and light yellowish brown silt loam about 22 inches thick. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Bakeoven and Lickskillet soils. Also included are small areas of Condon soils that have slopes of 1 to 12 percent or 20 to 30 percent and soils that are similar to this Condon soil but have 15 to 50 percent rock fragments. Included areas make up about 35 percent of the total acreage.

Permeability of this Condon soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for nonirrigated small grain. It is also used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock, droughtiness, and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control

erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the steepness of slope and the high percentage of included soils that are shallow or very shallow. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

21D—Condon-Bakeoven complex, 2 to 20 percent slopes. This map unit is on broad summits of hills. Elevation is 1,600 to 2,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 125 to 165 days.

This unit is 40 percent Condon silt loam and 30 percent Bakeoven very cobbly loam. The percentage varies from one area to another. The soils occur as patterned land, locally known as biscuit-scabland. The Bakeoven soil occurs as scabland between and around the areas of the Condon soil. The Condon soil occurs as circular mounds, or biscuits, that have a convex surface and are deepest in the center. The components of this unit are so intricately intermingled that it was not practical to map them at the scale used.

Included in this unit are small areas of Lickskillet soils and soils that are similar to this Condon soil but have 15 to 50 percent rock fragments. Also included are small areas of Condon and Bakeoven soils that have slopes of 20 to 30 percent. Included areas make up about 30 percent of the total acreage.

The Condon soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and light yellowish brown silt loam about 22 inches thick. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Condon soil is moderate. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Bakeoven soil is very shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is brown very cobbly loam about 3 inches thick. The subsoil is brown very gravelly loam and clay loam about 5 inches thick. Basalt is at a depth of 8 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of the Bakeoven soil is moderately slow. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 4 to 12 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Condon soil is mainly Idaho fescue and bluebunch wheatgrass. The potential plant community on the Bakeoven soil is mainly Sandberg bluegrass. Stiff sagebrush grows in some areas. The production of forage is limited by the high content of rock fragments and the very shallow depth of the Bakeoven soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding or other mechanical or chemical treatment is poor. The main limitation for treatment is the interspersed areas of the very shallow Bakeoven soil. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

22C—Cowsly silt loam, 2 to 12 percent slopes. This deep, moderately well drained soil is on plateaus. It formed in loess and residuum. Elevation is 2,800 to 4,000 feet. The average annual precipitation is 22 to 30 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 90 days.

Typically, the surface is covered with a mat of needles and twigs about 2 inches thick. The surface layer is silt loam about 6 inches thick. The subsurface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil is brown silty clay loam about 15 inches thick. Below this is light gray silt loam about 5 inches thick over a buried subsoil of brown silty clay about 26 inches thick. Depth to basalt is 60 inches or more. In some

areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Tolo and Waha soils. Also included are small areas of soils that are similar to this Cowsly soil but that have less than 40 percent clay in the subsoil and Cowsly soils that have 12 to 20 percent slopes. Included areas make up about 15 percent of the total acreage.

Permeability of this Cowsly soil is moderate to a depth of 34 inches and very slow below this depth. Available water capacity is about 9 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. Water is perched above the silty clay subsoil during March through May.

Most areas of this unit are used for nonirrigated crops and pasture. The main crop is annually grown winter or spring small grain. Some areas are used for small grain and peas grown in rotation. A few areas are used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the water table that is perched in spring and the hazard of water erosion.

Because of the perched water table, the soil remains wet for long periods in spring. When the soil is in this condition, it is subject to displacement, compaction, and erosion. Tillage equipment should be kept off the soil until it has drained.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling and subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for hay and pasture, the main limitations are the perched water table and the hazard of water erosion.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Fertilizer is needed to ensure optimum growth of grasses and legumes.

This unit is suited to the production of ponderosa pine and Douglas-fir. The understory in mainly elk sedge, pinegrass, and common snowberry.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 105. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 97 cubic feet per acre. The mean annual increment at culmination (CMAI) for 40-year-old trees 0.6 inch and larger in diameter at breast height is 112 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction, soil displacement, and erosion.

Because of the perched water table, the soil in this unit readily becomes saturated in spring. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity. Harvesting of timber on this unit should be restricted to the summer or winter, when the soil is dry or frozen.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both. Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are very slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by ponderosa pine and Douglas-fir occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. Seedlings planted in the silty clay subsoil grow poorly. Undesirable plants reduce adequate natural or artificial reforestation. Intensive site preparation and maintenance generally are not needed.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

22D—Cowsly silt loam, 12 to 20 percent slopes. This deep, moderately well drained soil is on plateaus. It formed in loess and residuum. Elevation is 2,800 to 4,000 feet. The average annual precipitation is 22 to 30 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 90 days.

Typically, the surface is covered with a mat of needles and twigs about 2 inches thick. The surface layer is silt loam about 6 inches thick. The subsurface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil is brown silty clay loam about 15 inches thick. The next layer is light gray silt loam about 5 inches thick. Below this is a buried subsoil of brown silty clay about 26 inches thick. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Tolo and Waha soils. Also included are small areas of soils that are similar to this Cowsly soil but that have less than 40 percent clay in the subsoil and Cowsly soils that have 2 to 12 percent slopes or 20 to 30 percent slopes. Included areas make up about 20 percent of the total acreage.

Permeability of this Cowsly soil is moderate to a depth of 34 inches and very slow below this depth. Available water capacity is about 9 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. Water is perched above the silty clay subsoil during March through May.

Most areas of this unit are used for nonirrigated small grain and pasture. A few areas are used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to nonirrigated crops and is cropped annually with winter or spring small grain. A few areas may be cropped by using a small grain-pea rotation. It is limited mainly by the perched water table in spring and the hazard of water erosion.

Because of the perched water table, the soil remains wet for long periods in spring. When the soil is in this condition, it is subject to displacement, compaction, and erosion. Tillage equipment should be kept off the soil until it has drained.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for hay and pasture, the main limitations are the perched water table and the hazard of water erosion.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Fertilizer is needed to ensure optimum growth of grasses and legumes.

This unit is suited to the production of ponderosa pine and Douglas-fir. The understory is mainly elk sedge, pinegrass, and common snowberry.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 105; thus, the mean annual increment for 80-year-old trees 6.6 inches in diameter or larger at breast height is 97 cubic feet per acre. The mean annual increment at culmination (CMAI) for 40-year-old trees 0.6 inch in diameter or larger at breast height is 112 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction, soil displacement, and erosion and steepness of slope.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Because of the perched water table, the soil in this unit readily becomes saturated in spring. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity. Harvesting of timber on this unit should be restricted to summer or winter, when the soil is dry or frozen.

In the more steeply sloping areas, road location is more difficult and maintenance costs are greater. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are very slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by ponderosa pine and Douglas-fir occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. Seedlings planted in the silty clay subsoil grow poorly. Undesirable plants reduce adequate natural or artificial reforestation. Intensive site preparation and maintenance generally are not needed.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

23—Dune land. This map unit consists of deep, excessively drained soils on terraces of the Columbia River. It formed in eolian sand. Slope is 0 to 30 percent. Areas are strongly convex and are dunelike, hummocky, or hilly. The dunes are long and narrow and are oriented in a northeast-to-southwest direction. Elevation is 350 to 1,200 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Dune land is light gray to dark grayish brown loamy sand, fine sand, or sand 60 inches thick or more.

Included in this unit are small areas of Adkins, Koehler, Quincy, Ritzville, Sagehill, Shano, and Taunton soils. Included areas make up about 30 percent of the total acreage; however, the percentage varies from one area to another.

Permeability of Dune land is rapid to very rapid. Available water capacity is 2 to 5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used for wildlife habitat and for a limited amount of livestock grazing.

The present vegetation in some areas is mainly scattered clumps of cheatgrass, big sagebrush, and antelope bitterbrush.

It is difficult to establish desirable rangeland grasses on this unit because of the very high hazard of soil blowing. Soil blowing can be reduced by seeding with permanent grasses and mulching. Suitable materials include straw, asphalt, jute netting, and gravel or a combination of these materials.

24B—Ellisforde silt loam, 1 to 7 percent slopes. This deep, well drained soil is on terraces. It formed in loess that has been deposited over lacustrine sediment. Elevation is 500 to 900 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Ellisforde, eroded, soils; Ritzville soils; and soils that are similar to this Ellisforde soil but that have lacustrine sediment at a depth of 10 to 20 inches. Also included are small areas of Ellisforde soils that have slopes of 7 to 20 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Ellisforde soil is moderate to a depth of 28 inches and moderately slow below this depth. Available water capacity is about 11.0 to 13.5 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for irrigated crops such as alfalfa seed and small grain. Among the other crops grown are alfalfa hay, tree fruit, pasture, and nonirrigated small grain. Some areas are used for homesite development and rangeland.

This unit is suited to irrigated crops. Sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating, developing a perched water table, and increasing the risk of erosion, application of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 10 to 12 years of alfalfa for seed and 2 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for nonirrigated crops, it is limited by the moderate hazard of water erosion. A cropping

system that includes small grain and summer fallow is most suitable because precipitation is not sufficient for annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass.

24C—Ellisforde silt loam, 7 to 20 percent slopes. This deep, well drained soil is on terraces and terrace scarps. It formed in loess that has been deposited over lacustrine sediment. Elevation is 500 to 900 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Ellisforde, eroded, soils; Ritzville soils; and soils that are similar to this Ellisforde soil but that have lacustrine sediment at a depth of 10 to 20 inches. Also included are small areas of Ellisforde soils that have slopes of 1 to 7 percent or 20 to 40 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Ellisforde soil is moderate to a depth of 28 inches and moderately slow below this depth. Available water capacity is about 11.0 to 13.5 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for irrigated crops such as alfalfa seed and small grain. Among the other crops grown are alfalfa hay, tree fruit, pasture, and nonirrigated small grain. Some areas are used for homesite development and rangeland.

The more gently sloping areas of this unit are suitable for irrigated crops. Because of slope, sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 10 to 12 years of alfalfa for seed and 2 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for nonirrigated crops, it is limited by the high hazard of water erosion. A cropping system that includes small grain and summer fallow is most suitable because precipitation is not sufficient for annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass.

25C—Ellisforde-Ellisforde, eroded complex, 1 to 20 percent slopes. This map unit is on dissected terraces. Elevation is 500 to 900 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is 65 percent Ellisforde silt loam and 30 percent Ellisforde very fine sandy loam, eroded. The components of this unit are so intricately intermingled that it was not practical to map them at the scale used.

Included in this unit are small areas of Ritzville soils and Ellisforde, eroded, soils that have slopes of 20 to 30 percent. Included areas make up about 5 percent of the total acreage.

The Ellisforde soil is deep and well drained. It formed in loess that has been deposited over lacustrine sediment and is on north- and east-facing slopes and on broad ridges. Typically, the surface layer is brown silt loam about 10 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. Depth to basalt is 60 inches or more.

Permeability of the Ellisforde soil is moderate to a depth of 28 inches and moderately slow below this depth. Available water capacity is about 11.0 to 13.5 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Ellisforde, eroded, soil is deep and well drained. It formed in loess that has been deposited over lacustrine sediment and is on south- and west-facing slopes and on narrow ridges. Typically, the surface layer is light brownish gray very fine sandy loam about 6 inches thick. The subsoil is light gray and light brownish gray silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light brownish gray silt loam and very fine sandy loam. Depth to basalt is 60 inches or more.

Permeability of the Ellisforde, eroded, soil is moderate to moderately slow. Available water capacity is about 11.0 to 13.5 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated alfalfa for seed, small grain, and alfalfa hay.

Because of slope and the undulating topography of this unit, sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and developing a perched water table or increasing the risk of erosion, application of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 10 to 12 years of alfalfa for seed and 2 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

26E—Entic Durochrepts, 20 to 40 percent slopes. These shallow to moderately deep, well drained soils are on terrace scarps. The soils formed in loess over cemented alluvium. Elevation is 1,100 to 2,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 140 to 165 days.

The surface layer ranges from silt loam and loam to extremely cobbly silt loam and loam. The underlying layers range from very gravelly silt loam to very gravelly clay loam over a hardpan. Depth to the hardpan ranges from 10 to 40 inches.

Included in this unit are small areas of Lickskillet and Pilot Rock soils and Entic Durochrepts that have slopes of 10 to 20 percent. Included areas make up about 30 percent of the total acreage.

Permeability of these Entic Durochrepts is moderate to a depth of 11 inches and very slow below this depth. Available water capacity is about 1.0 inch to 3.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit varies; however, plants that may be present in the community include bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the high content of rock fragments in the soil and the restricted depth to the hardpan. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding is poor. The main limitations are the steepness of slope and the high content of rock fragments in the soil. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

27A—Esquatzel silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in silty alluvium. Elevation is 500 to 900 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is 52 to 53 degrees F, and the average frost-free period is 160 to 180 days.

Typically, the surface layer is brown silt loam about 21 inches thick. The substratum to a depth of 60 inches or more is brown and grayish brown, stratified silt loam and very fine sandy loam. In some areas there is no accumulation of calcium carbonate in the profile.

Included in this unit are small areas of Kimberly, Powder, and Yakima soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Esquatzel soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly small grain, alfalfa hay, row crops, and orchards. Some areas are used for homesite development and pasture.

This unit is suited to irrigated crops. It has few limitations.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or corn. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen, phosphorous, and sulfur fertilizer are needed to maintain production of high quality irrigated pasture.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this problem.

28A—Freewater gravelly silt loam, 0 to 3 percent slopes. This deep, somewhat excessively drained soil is on flood plains. It formed in mixed alluvium. The native vegetation in areas not cultivated is mainly grasses, shrubs, and forbs. Elevation is 800 to 1,400 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 145 to 195 days.

Typically, the surface layer is dark grayish brown gravelly silt loam about 4 inches thick. The subsurface layer is dark grayish brown very gravelly loam about 16 inches thick. The substratum to a depth of 60 inches or more is dark grayish brown and brown extremely gravelly sand. In some areas the surface layer is very cobbly or very gravelly loam.

Included in this unit are small areas of Veazie soils, Xerofluvents, and Yakima soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Freewater soil is moderate to a depth of 20 inches and very rapid below this depth. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this unit are used for irrigated field crops and tree fruit such as apples, plums, peaches, pears, apricots, and cherries. Among the other crops grown are alfalfa hay, small grain, and asparagus. Some areas are used for pasture and homesite development.

This unit is suited to irrigated crops. It is limited mainly by the very rapid permeability of the substratum, the low available water capacity, and the high content of rock fragments in the soil.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Handline, solid set, and overhead sprinkler systems are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Overhead sprinklers are also effective in orchards for frost control early in spring.

If gravity irrigation systems are used, water should be applied at frequent intervals and runs should be short. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Competition for moisture from grasses and weeds in areas between fruit trees can be reduced by mowing or clean cultivating. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for pasture, proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the sprinkler and border methods. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients. Leveling helps to ensure the uniform application of water.

If this unit is used for homesite or urban development, the main limitations are the very rapid permeability of the substratum, the high content of rock fragments in the soil, and the rare periods of flooding.

Removal of pebbles and cobbles in disturbed areas is needed for best results when landscaping, particularly in areas used for lawns. It is difficult to establish plants in areas where the surface and subsurface layers have been removed, exposing the extremely gravelly

substratum. Mulching and fertilizing cut areas help to establish plants. In summer, irrigation is required for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

The very rapid permeability of the substratum adversely affects the purification action of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

29A—Freewater very cobbly loam, 0 to 3 percent slopes. This deep, somewhat excessively drained soil is on flood plains. It formed in mixed alluvium. Elevation is 800 to 1,400 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 145 to 195 days.

Typically, 15 to 25 percent of the surface is covered with cobbles, although this percentage may be as high as 80 percent in areas that have been cultivated for several years. The surface layer is dark grayish brown very cobbly loam about 4 inches thick. The subsurface layer is dark grayish brown very gravelly loam about 16 inches thick. The substratum to a depth of 60 inches or more is dark grayish brown and brown extremely gravelly sand. In some areas the surface layer is extremely cobbly or very gravelly loam.

Included in this unit are small areas of Veazie soils, Xerofluvents, and Yakima soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Freewater soil is moderate to a depth of 20 inches and very rapid below this depth. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this unit are used for tree fruit such as apples, plums, peaches, pears, apricots, and cherries (fig. 5). A few areas are used for pasture and for homesite and urban development.

This unit is suited to irrigated crops. It is limited mainly by the very rapid permeability, low available water capacity, and high content of rock fragments on the surface and in the soil.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Handlines, solid set, and overhead sprinkler systems are used. Use of sprinkler systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Overhead sprinklers are also effective in orchards for frost control early in spring.

If gravity irrigation systems are used, water should be applied at frequent intervals and runs should be short. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Competition for moisture from grasses and weeds in areas between fruit trees can be reduced by mowing or clean cultivating. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Cobbles on the surface limit the use of most equipment and increase maintenance costs.

If this unit is used for pasture, proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the sprinkler and border methods. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients. Leveling helps to ensure the uniform application of water.

If this unit is used for homesite or urban development, the main limitations are the very rapid permeability of the substratum, the high content of coarse fragments on the surface and in the soil, and the rare periods of flooding.

Removal of pebbles and cobbles in disturbed areas is needed for best results when landscaping, particularly in areas used for lawns. It is difficult to establish plants in areas where the surface and subsurface layers have been removed, exposing the extremely gravelly substratum. Mulching and fertilizing cut areas help to establish plants. In many areas it may be necessary to haul in topsoil for lawns and gardens. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

The very rapid permeability of the substratum adversely affects the purification action of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Figure 5.—Fruit trees in an area of Freewater very cobbly loam, 0 to 3 percent slopes.

30A—Freewater-Urban land complex, 0 to 3 percent slopes. This map unit is on flood plains. Elevation is 800 to 1,000 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 195 days.

This unit is 60 percent Freewater soils and 30 percent Urban land.

Included in this unit are small areas of Veazie and Yakima soils. Included areas make up about 10 percent of the total acreage.

The Freewater soil is deep and somewhat excessively drained. It formed in mixed alluvium. Typically, 15 to 25 percent of the surface is covered with cobbles. The surface layer is dark grayish brown very cobbly loam about 4 inches thick. The subsurface layer is dark grayish brown very gravelly loam about 16 inches thick. The substratum to a depth of 60 inches or more is very dark brown and brown extremely gravelly sand. In some areas the surface layer is extremely cobbly or very gravelly loam.

Permeability of the Freewater soil is moderate to a depth of 20 inches and very rapid below this depth. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

This unit is used for homesite and urban development. It is limited mainly by the very rapid permeability of the substratum and the high content of rock fragments on the surface and in the soil.

Removal of pebbles and cobbles in disturbed areas is needed for best results when landscaping, particularly in

areas used for lawns. It is difficult to establish plants in areas where the surface and subsurface layers have been removed, exposing the extremely gravelly substratum. Mulching and fertilizing cut areas help to establish plants. In many areas it may be necessary to haul in topsoil for lawns and gardens. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

The very rapid permeability of the substratum adversely affects the purification process of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

31B—Gurdane silty clay loam, 0 to 7 percent slopes. This moderately deep, well drained soil is on broad summits of hills of the Blue Mountains. It formed in loess and residuum. Elevation is 1,600 to 4,500 feet. The average annual precipitation is 16 to 24 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 130 days.

Typically, the surface layer is dark gray silty clay loam about 9 inches thick. The upper 11 inches of the subsoil is dark grayish brown silty clay loam, and the lower 10 inches is brown very cobbly clay. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Gwinly, Rockly, and Waha soils. Also included are small areas of Gurdane soils that have slopes of 7 to 25 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Gurdane soil is very slow. Available water capacity is about 3 to 7 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated small grain and as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock, the very slow permeability of the subsoil, and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

31D—Gurdane silty clay loam, 7 to 25 percent slopes. This moderately deep, well drained soil is on broad summits of hills in the Blue Mountains. It formed in loess and residuum. Slopes are north- and east-facing. Elevation is 1,600 to 4,500 feet. The average annual precipitation is 16 to 24 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 130 days.

Typically, the surface layer is dark gray silty clay loam about 9 inches thick. The upper 11 inches of the subsoil is dark grayish brown silty clay loam, and the lower 10 inches is brown very cobbly clay. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Gwinly, Palouse, Rockly, and Waha soils. Also included are small areas of soils that are similar to this Gurdane soil but are underlain by sandstone and Gurdane soils that have slopes of 1 to 7 percent or 25 to 45 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Gurdane soil is very slow. Available water capacity is about 3 to 7 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for nonirrigated small grain and as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock, the very slow permeability of the subsoil, and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope and limited soil depth, gradient terraces rather than level ones may be more suitable.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

31E—Gurdane silty clay loam, 25 to 45 percent slopes. This moderately deep, well drained soil is on hillslopes of the Blue Mountains. It formed in loess and residuum. Slopes are north- and east-facing. Elevation is 1,600 to 4,500 feet. The average annual precipitation is 16 to 24 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 130 days.

Typically, the surface layer is dark gray silty clay loam about 9 inches thick. The upper 11 inches of the subsoil is dark grayish brown silty clay loam, and the lower 10 inches is brown very cobbly clay. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Buckcreek, Gwinly, Palouse, Rockly, and Waha soils and Rock outcrop. Also included are small areas of soils that are similar to this Gurdane soil but are underlain by sandstone or that have basalt at a depth of more than 40 inches and small areas of Gurdane soils that have slopes of 5 to 25 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Gurdane soil is very slow. Available water capacity is about 3 to 7 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding is poor. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper areas of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails and walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

32E—Gurdane-Gwinly association, 20 to 40 percent slopes. This map unit is on hillslopes of the Blue Mountains. Elevation is 2,000 to 4,500 feet. The average annual precipitation is 16 to 24 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 130 days.

This unit is 45 percent Gurdane silty clay loam and 35 percent Gwinly very cobbly silt loam. The percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them at the scale used.

Included in this unit are small areas of Rockly, Buckcreek, and Waha soils, Rock outcrop, and Rubble land. Also included are small areas of Gurdane and Gwinly soils that have slopes of 10 to 20 percent. Included areas make up about 20 percent of the total acreage.

The Gurdane soil is moderately deep and well drained. It formed in loess and residuum on north- and east-facing slopes. Typically, the surface layer is dark gray silty clay loam about 9 inches thick. The upper 11 inches of the subsoil is dark grayish brown silty clay loam, and the lower 10 inches is brown very cobbly clay. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Permeability of this Gurdane soil is very slow. Available water capacity is about 3 to 7 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Gwinly soil is shallow and well drained. It formed in colluvium, residuum, and loess on south- and west-facing slopes. Typically, 1 to 10 percent of the surface is covered with stones. The surface layer is dark grayish brown very cobbly silt loam about 2 inches thick. The upper 5 inches of the subsoil is dark grayish brown very cobbly silty clay loam, and the lower 8 inches is dark brown very cobbly clay. Basalt is at a depth of 15 inches. Depth to basalt ranges from 10 to 20 inches.

Permeability of this Gwinly soil is slow. Available water capacity is about 0.5 inch to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Gurdane soil is mainly Idaho fescue and bluebunch wheatgrass. The potential plant community on the Gwinly soil is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the high content of rock fragments and the shallow depth of the Gwinly soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding is poor. The main limitations for seeding are the steepness of slope and the high content of rock fragments in the Gwinly soil.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Because of slope and the high content of rock fragments in the soils, mechanical treatment generally is not practical.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails and walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

33D—Gurdane-Rockly complex, 2 to 20 percent slopes. This map unit is on ridges in the foothills of the Blue Mountains. Elevation is 1,700 to 4,500 feet. The average annual precipitation is 16 to 24 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 120 days.

This unit is 45 percent Gurdane silty clay loam and 35 percent Rockly very cobbly silt loam. The percentage varies from one area to another. The soils occur as patterned land, locally known as biscuit-scabland. The Rockly soil occurs as areas of scabland between and around the areas of the Gurdane soil. The Gurdane soil occurs as circular mounds, or biscuits, that have a convex surface and are deepest in the center.

Included in this unit are small areas of Gwinly and Waha soils. Included areas make up about 20 percent of the total acreage.

The Gurdane soil is moderately deep and well drained. It formed in loess and residuum. Typically, the surface layer is dark gray silty clay loam about 9 inches thick. The upper 11 inches of the subsoil is dark grayish brown silty clay loam, and the lower 10 inches is brown very cobbly clay. Basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Permeability of the Gurdane soil is very slow. Available water capacity is about 3 to 7 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Rockly soil is very shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is brown very cobbly loam about 2 inches thick. The subsoil is brown very cobbly loam about 4 inches thick. Basalt is at a depth of 6 inches. Depth to basalt ranges from 5 to 12 inches.

Permeability of the Rockly soil is moderately slow. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 5 to 12 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Gurdane soil is mainly Idaho fescue and bluebunch wheatgrass. The potential plant community on the Rockly soil is mainly Sandberg bluegrass, bluebunch wheatgrass, and stiff

sagebrush. The production of forage is limited by the high content of rock fragments and the very shallow depth of the Rockly soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding or other mechanical or chemical treatment is poor. The main limitation for treatment is the interspersed areas of the very shallow Rockly soil. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

34F—Gwin-Klicker-Rock outcrop complex, 30 to 70 percent slopes. This map unit is on hillslopes of the Blue Mountains. Slopes generally are south-facing. Elevation is 2,500 to 4,500 feet. The average annual precipitation is 17 to 28 inches, the average annual air temperature is 43 to 47 degrees F, and the average frost-free period is 60 to 110 days.

This unit is 35 percent Gwin extremely stony silt loam, 20 percent Klicker very stony silt loam, and 15 percent Rock outcrop. The percentage varies from one area to another.

Included in this unit are small areas of Anatone, Bocker, Kahler, and Umatilla soils. Also included are small areas of soils that are similar to this Klicker soil but are more than 40 inches deep to bedrock, Gwin and Klicker soils that have slopes of 10 to 30 percent or more than 70 percent, and Rock outcrop. Included areas make up about 30 percent of the total acreage.

The Gwin soil is shallow and well drained. It formed in colluvium, residuum, and loess on south-facing slopes. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is dark grayish brown extremely stony silt loam about 7 inches thick. The subsoil is brown very cobbly silty clay loam about 6 inches thick. Basalt is at a depth of 13 inches. Depth to basalt ranges from 10 to 20 inches.

Permeability of the Gwin soil is moderately slow. Available water capacity is about 1.5 to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Klicker soil is moderately deep and well drained. It formed in loess and residuum on south-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown very stony silt loam about 7 inches thick. The subsoil is dark brown very cobbly silty clay loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is stony.

Permeability of the Klicker soil is moderately slow. Available water capacity is about 2.5 to 7.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of areas of exposed basalt and generally occurs as rimrock near the top of slopes.

Most areas of this unit are used for livestock grazing and wildlife habitat. A few areas are used for timber production.

The potential plant community on the Gwin soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. The potential understory on the Klicker soil is mainly western fescue, serviceberry, and elk sedge. If the rangeland or woodland understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The production of forage is limited by steepness of slope, the areas of Rock outcrop, and depth to bedrock.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system. Mechanical treatment is not practical, because the surface is stony and the slopes are steep. The suitability of this unit for rangeland seeding is poor. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

This unit is suited to the production of ponderosa pine in the more readily accessible areas; however, it generally is not suitable for commercial timber. Other species that grow on this unit include Douglas-fir. The understory is mainly Oregon-grape, common snowberry, elk sedge, and pinegrass.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 76 on the Klicker soil. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 51 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 63 cubic feet per acre.

The main limitations for the management of timber are steepness of slope, the hazards of compaction and erosion, and the high content of rock fragments in the soil.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Cable yarding systems are safer, and their use minimizes damage to the soil and helps to maintain productivity.

Locating roads on midslope results in large cuts and fills and thus removes land from production. Material

cast to the side when building roads can damage vegetation. It is also a potential source of sedimentation. End hauling of waste material minimizes damage to vegetation downslope and reduces the potential of sedimentation. Seeding road cuts and fills to a permanent plant cover reduces erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by ponderosa pine occurs if a seed source is present. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings.

Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate. Because roots are restricted by bedrock, trees are subject to windthrow.

35F—Gwin-Rock outcrop complex, 40 to 70 percent slopes. This map unit is on hillslopes in the foothills of the Blue Mountains. Slopes are convex and generally are south- or west-facing. Elevation is 1,500 to 4,800 feet. The average annual precipitation is 16 to 28 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

This unit is 55 percent Gwin extremely stony silt loam and 10 percent Rock outcrop. The percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them at the scale used.

Included in this unit are small areas of Bowlus, Buckcreek, Gurdane, Kahler, Rockly, Umatilla, and Waha soils and soils that are similar to this Gwin soil but are 20 to 30 inches deep. Also included are small areas of Gwin and Gwinly soils that have slopes of 10 to 40 percent and soils that are similar to this Gwin soil but are underlain by sandstone. Included areas make up about 35 percent of the total acreage.

The Gwin soil is shallow and well drained. It formed in colluvium, residuum, and loess. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is dark grayish brown very cobbly silt loam about 7 inches thick. The subsoil is brown very cobbly silty clay loam about 6 inches thick. Basalt is at a depth of 13 inches. Depth to basalt ranges from 10 to 20 inches.

Permeability of the Gwin soil is moderately slow. Available water capacity is about 1.5 to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of areas of exposed basalt.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. The production of forage is limited by the high content of rock fragments in the soil and the shallow depth to bedrock.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface is stony and the slopes are steep.

Steepness of slope and the areas of Rock outcrop limit access by livestock and promote overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

36E—Gwinly very cobbly silt loam, 7 to 40 percent slopes. This shallow, well drained soil is on hillslopes in the foothills of the Blue Mountains. It formed in colluvium, residuum, and loess. Slopes are convex and generally are south- or west-facing. Elevation is 1,500 to 4,200 feet. The average annual precipitation is 16 to 25 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

Typically, 1 to 10 percent of the surface is covered with stones. The surface layer is dark grayish brown very cobbly silt loam about 2 inches thick. The upper 5 inches of the subsoil is dark grayish brown very cobbly silty clay loam, and the lower 8 inches is dark brown very cobbly clay. Basalt is at a depth of 15 inches. Depth to basalt ranges from 10 to 20 inches.

Included in this unit are small areas of Gurdane and Rockly soils and Rock outcrop. Also included are small areas of Gwin and Gwinly soils that have slopes of 40 to 70 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Gwinly soil is slow. Available water capacity is about 0.5 inch to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. The production of forage is limited by the high content of rock fragments in the soil and the shallow depth to bedrock.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface is stony and the slopes are steep.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

37C—Hankins silt loam, 2 to 15 percent slopes. This deep, well drained soil is on foot slopes. It formed in loess and tuffaceous sediment. Elevation is 3,300 to 4,300 feet. The average annual precipitation is 16 to 25 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 90 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is grayish brown silt loam about 9 inches thick. The upper 11 inches of the subsoil is brown silty clay loam, and the lower 6 inches is dark brown clay. The substratum is yellowish brown clay loam 18 inches over partially weathered tuffaceous sediment. Depth to tuff ranges from 40 to 60 inches or more.

Included in this unit are small areas of Anatone, Bridgecreek, Klicker, Silvies, Winom, and Tolo soils. Also included are small areas of Hankins soils that have slopes of 15 to 35 percent. Included areas make up about 35 percent of the total acreage.

Permeability of this Hankins soil is slow to very slow. Available water capacity is about 4.5 to 11.0 inches. Effective rooting depth is 40 to 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of ponderosa pine. The understory is mainly elk sedge, common snowberry, pinegrass, and Idaho fescue.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 72. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 46 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 58 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction, soil displacement, and erosion.

Because of the slow permeability of the clay subsoil, the soil in this unit readily becomes saturated in spring. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity. Harvesting of timber on this unit should be restricted to summer or winter, when the soil is dry or frozen.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are very slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine seedlings. Seedlings planted in the heavy clay subsoil grow poorly. Undesirable plants limit adequate natural or artificial reforestation; however, intensive site preparation and maintenance generally are not needed.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

37E—Hankins silt loam, 15 to 35 percent slopes. This deep, well drained soil is on foot slopes. It formed in loess and tuffaceous sediment. Elevation is 3,300 to 4,300 feet. The average annual precipitation is 16 to 25 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 90 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is grayish brown silt loam about 9 inches thick. The upper 11 inches of the subsoil is brown silty clay loam, and the lower 6 inches is dark brown clay. The substratum is yellowish brown clay loam 18 inches thick over partially weathered tuffaceous sediment. Depth to tuff ranges from 40 to 60 inches.

Included in this unit are small areas of Anatone, Bridgecreek, Klicker, Silvies, Winom, and Tolo soils. Also included are small areas of Hankins soils that have slopes of 2 to 15 percent or 35 to 50 percent. Included areas make up about 40 percent of the total acreage.

Permeability of this Hankins soil is slow to very slow. Available water capacity is about 4.5 to 11.0 inches. Effective rooting depth is 40 to 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of ponderosa pine. The understory is mainly elk sedge, common snowberry, pinegrass, and Idaho fescue.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 72. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 46 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 58 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction, soil displacement, and erosion and the steepness of slope.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Because of the slow permeability of the clay subsoil, the soil in this unit readily becomes saturated in spring. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity. Harvesting of timber on this unit should be restricted to summer or winter, when the soil is dry or frozen.

In the more steeply sloping areas, road location is more difficult and maintenance costs are greater. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are very slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine seedlings. Seedlings planted in the heavy clay subsoil grow poorly. Undesirable plants limit adequate natural or artificial reforestation; however, intensive site preparation and maintenance generally are not needed.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

38C—Helter silt loam, 2 to 15 percent slopes. This deep, well drained soil is on plateaus of the Blue Mountains. It formed in volcanic ash over a buried soil. Elevation is 4,500 to 5,500 feet. The average annual precipitation is 35 to 60 inches, the average annual air temperature is 40 to 44 degrees F, and the average frost-free period is 20 to 60 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is grayish brown silt loam about 6 inches thick. The subsoil is very pale brown silt loam about 27 inches thick. Below this is a buried subsoil of light yellowish brown and pale brown silt loam and gravelly silt loam about 27 inches thick. Basalt is at a depth of 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of soils that are similar to Anatone and Klicker soils. Also included are small areas of wet soils and Helter soils that have slopes of 15 to 35 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Helter soil is moderate to a depth of 33 inches and moderately slow below this depth. Available water capacity is about 12 to 19 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for timber production and wildlife habitat. A few areas are used for homesite development and recreation.

This unit is suited to the production of subalpine fir and grand fir. Other species that grow on this unit include Engelmann spruce, western larch, and lodgepole pine. The understory is mainly princes pine, grouse blueberry, and elk sedge.

On the basis of a 100-year site curve, the mean site index for subalpine fir is 100. The mean annual increment at culmination (CMAI) for 80-year-old trees 0.6 inch and larger in diameter at breast height is 109 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction and erosion.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily when the soil is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.

Natural reforestation of harvested areas by subalpine fir, grand fir, western larch, and lodgepole pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting subalpine fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

38E—Helter silt loam, 15 to 35 percent slopes. This deep, well drained soil is on hillslopes of the Blue Mountains. It formed in volcanic ash over a buried soil. Elevation is 4,500 to 5,500 feet. The average annual precipitation is 35 to 60 inches, the average annual air temperature is 40 to 44 degrees F, and the average frost-free period is 20 to 60 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is grayish brown silt loam about 6 inches thick. The subsoil is very pale brown silt loam about 27 inches thick. Below this is a buried subsoil of light yellowish brown and pale brown silt loam and gravelly silt loam about 27 inches thick. Basalt is at a depth of 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Anatone, Kahler, Klicker, and Umatilla soils. Also included are small areas of Helter soils that have slopes of 3 to 15 percent or 35 to 70 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Helter soil is moderate to a depth of 33 inches and moderately slow below this depth. Available water capacity is about 12 to 19 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for timber production and wildlife habitat. A few areas are used for homesite development and recreation.

This unit is suited to the production of subalpine fir and grand fir. Other species that grow on this unit include Engelmann spruce, western larch, and lodgepole pine. The understory is mainly princes pine, grouse blueberry, and elk sedge.

On the basis of a 100-year site curve, the mean site index for subalpine fir is 100. The mean annual increment at culmination (CMAI) for 80-year-old trees 0.6 inch and larger in diameter at breast height is 109 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction and erosion and steepness of slope.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily when the soil is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

In the more steeply sloping areas, road location is more difficult and maintenance costs are greater. Proper

design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.

Natural reforestation of harvested areas by subalpine fir, grand fir, western larch, and lodgepole pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting subalpine fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

39A—Hermiston silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in silty alluvium. Elevation is 700 to 2,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 150 to 195 days.

Typically, the surface layer is grayish brown silt loam about 16 inches thick. The subsoil to a depth of 60 inches or more is grayish brown, light yellowish brown, and pale brown silt loam. In some areas the surface layer is fine sandy loam or very fine sandy loam.

Included in this unit are small areas of Onyx soils and Vitrandepts. Also included are small areas of Pedigo and Yakima soils, Xerofluvents, and soils that are similar to this Hermiston soil but that have a water table within 6 feet of the surface. Included areas make up about 20 percent of the total acreage.

Permeability of this Hermiston soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly small grain and alfalfa hay. A few areas are used for row crops, pasture, nonirrigated small grain, rangeland, and homesite development.

This unit is suited to irrigated crops. It has few limitations.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Poor irrigation water management can cause excessive amounts of salt to accumulate near the soil surface. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or corn. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to nonirrigated crops. Many areas are cropped annually. In areas where precipitation is not sufficient for annual cropping, a system that includes small grain and summer fallow is more suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Other practices that can be used to conserve moisture include limiting tillage for seedbed preparation and weed control.

This unit is suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on this unit is mainly giant wildrye and basin big sagebrush.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen, phosphorous, and sulfur fertilizer are needed to maintain production of high quality irrigated pasture.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may

result. Using larger culverts helps to overcome this problem.

40C—Kahler silt loam, 2 to 15 percent slopes. This deep, well drained soil is on plateaus of the Blue Mountains. It formed in loess and colluvium. It is on north- and east-facing slopes. Elevation is 2,000 to 4,500 feet. The average annual precipitation is 15 to 45 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 30 to 90 days.

Typically, the surface is covered with a mat of needles and twigs 1 inch thick. The surface layer is dark brown and brown silt loam about 20 inches thick. The upper 17 inches of the subsoil is dark brown silty clay loam, and the lower 23 inches is brown cobbly silty clay loam. Basalt is at a depth of 60 inches or more.

Included in this unit are small areas of Klicker, Tolo, and Umatilla soils. Also included are small areas of soils that are similar to this Kahler soil but that are 20 to 60 inches deep to basalt and Kahler soils that have slopes of 15 to 35 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Kahler soil is moderate. Available water capacity is about 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir and ponderosa pine. The understory is mainly elk sedge, pinegrass, and mallow ninebark.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 75. Thus, the mean annual increment for 80-year-old trees is 70 cubic feet per acre. The mean annual increment at culmination (CMAI) is 71 cubic feet per acre at 96 years for trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are the hazards of soil compaction and erosion.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are soft and slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by Douglas-fir and ponderosa pine occurs if a seed source is present. Reforestation can be accomplished by planting Douglas-fir or ponderosa pine seedlings. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

40E—Kahler silt loam, 15 to 35 percent slopes. This deep, well drained soil is on north- and east-facing hillslopes of the Blue Mountains. It formed in loess and colluvium. Elevation is 2,000 to 4,500 feet. The average annual precipitation is 15 to 45 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 30 to 90 days.

Typically, the surface is covered with a mat of needles and twigs 1 inch thick. The surface layer is dark brown and brown silt loam about 20 inches thick. The upper 17 inches of the subsoil is dark brown silty clay loam, and the lower 23 inches is brown cobbly silty clay loam. Basalt is at a depth of 60 inches or more.

Included in this unit are small areas of Klicker, Tolo, and Umatilla soils. Also included are small areas of Rock outcrop, soils that are similar to this Kahler soil but that are 20 to 60 inches deep to basalt, and Kahler soils that have slopes of 2 to 15 percent or 35 to 70 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Kahler soil is moderate. Available water capacity is about 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir and ponderosa pine. The understory in mainly elk sedge, pinegrass, and mallow ninebark.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 75. Thus, the mean annual

increment for 80-year-old trees is 70 cubic feet per acre. The mean annual increment at culmination (CMAI) is 71 cubic feet per acre at 96 years for trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are the hazards of soil compaction and erosion and the steepness of slope.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity.

In the more steeply sloping areas, road location is more difficult and maintenance costs are greater. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are soft and slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by Douglas-fir and ponderosa pine occurs if a seed source is present. Reforestation can be accomplished by planting Douglas-fir seedlings. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

41F—Kahler gravelly loam, granite substratum, 35 to 70 percent slopes. This deep, well drained soil is on hillslopes of the Blue Mountains. It formed in loess, residuum, and colluvium. Elevation is 3,000 to 4,600 feet. The average annual precipitation is 20 to 26 inches, the average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 50 to 90 days.

Typically, the surface is covered with a mat of needles and twigs 2 inches thick. The surface layer is dark brown gravelly loam about 12 inches thick. The subsurface layer is dark brown loam about 10 inches thick. The subsoil is dark yellowish brown gravelly sandy clay loam about 23 inches thick. Below this to a depth of 60 inches or more is partially weathered granodiorite. In some areas the surface layer is loam or very gravelly loam.

Included in this unit are small areas of Kilmerque, Klicker, Tolo, and Umatilla soils. Also included are small areas of Rock outcrop and Kahler soils that have slopes of 15 to 35 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Kahler soil is moderate. Available water capacity is about 4.5 to 10.5 inches. Effective rooting depth is 40 to 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir and grand fir. Other species that grow on this unit include western larch and ponderosa pine. The understory in mainly princes pine, myrtle pachystima, and elk sedge.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 60. Thus, the mean annual increment for 80-year-old trees is 41 cubic feet per acre. The mean annual increment at culmination (CMAI) is 43 cubic feet per acre at 110 years for trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are the steepness of slope and the hazards of erosion and soil compaction.

Steepness of slope restricts the use of wheeled and tracked equipment on skid trails. Cable yarding generally is safer and disturbs the soil less.

Locating roads on midslopes results in large cuts and fills and thus removes land from production. Material cast to the side when building roads can damage vegetation. It is also a potential source of sedimentation. End hauling of waste material minimizes damage to vegetation downslope and reduces the potential of sedimentation. Seeding road cuts and fills to a permanent plant cover reduces erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by Douglas-fir and grand fir occurs if a seed source is present. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants prevent adequate natural or artificial reforestation unless intensive site preparation and maintenance are used.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

Because the overstory on this unit generally is very dense and forage production is low, livestock and wildlife usually graze areas that have been opened by logging or fire. Wildlife use this unit primarily as shelter from winter storms.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

42A—Kimberly fine sandy loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in mixed alluvium. Elevation is 400 to 2,000 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 49 to 53 degrees F, and the average frost-free period is 150 to 180 days.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The upper 4 inches of the substratum is pale brown fine sandy loam, and the lower part to a depth of 60 inches or more is pale brown and brown, stratified very fine sandy loam and silt loam. In some areas the surface layer is silt loam, very fine sandy loam, or loamy fine sand. In many areas there is a gravelly substratum at a depth of 40 to 60 inches.

Included in this unit are small areas of Esquatzel, Hermiston, and Quincy soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Kimberly soil is moderately rapid. Available water capacity is about 6 to 9 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is subject to brief periods of flooding in winter and spring. In some areas there may be a water table within 6 feet of the surface.

Most areas of this unit are used for irrigated crops such as small grain and alfalfa hay and for nonirrigated small grain. A few areas are used for pasture, range, and homesite development.

This unit is suited to irrigated crops. It is limited mainly by the low available water capacity and the moderate hazard of soil blowing.

Sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Furrow, border, and corrugation systems are also suited to this unit. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses.

This unit is suited to nonirrigated crops. The main needs in cropland management are to protect the unit from soil blowing and to conserve moisture for plant growth.

Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable. Other practices that can be used to conserve soil moisture and reduce soil blowing include stubble-mulch tillage, limiting tillage for seedbed preparation and weed control, and stripcropping, where practical.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly basin wildrye, needleandthread, and big sagebrush. The production of forage is limited by the low rainfall. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing and the low rainfall. Establishment of seedlings may be difficult because of these limitations. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for hay and pasture, the main limitations are the moderate hazard of soil blowing and the low available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water.

If this unit is used for windbreaks and environmental plantings, the main limitations are the low rainfall and the moderate hazard of soil blowing. If irrigation is used, most climatically adapted trees and shrubs can be grown. Among the trees that are suitable for planting are Rocky Mountain juniper and Lombardy poplar. Among the shrubs is caragana.

If this unit is used for homesite development, the main limitations are the low annual precipitation, the moderate hazard of soil blowing, and the hazard of flooding.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this problem.

43A—Kimberly silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in mixed alluvium. Elevation is 400 to 2,000 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 49 to 53 degrees F, and the average frost-free period is 150 to 180 days.

Typically, the surface layer is brown silt loam about 10 inches thick. The upper 4 inches of the substratum is pale brown fine sandy loam, and the lower part to a depth of 60 inches or more is pale brown and brown, stratified very fine sandy loam and silt loam. Some pedons have a silt loam or fine sandy loam surface layer. Many areas of this unit have a gravelly substratum at a depth of 40 to 60 inches.

Included in this unit are small areas of Esquatzel, Hermiston, Ritzville, and Shano soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Kimberly soil is moderately rapid. Available water capacity is about 6 to 9 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is subject to brief periods of flooding in winter and spring.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for irrigated crops, as rangeland, and for homesite development.

This unit is suited to nonirrigated crops. The main needs in cropland management are to protect the soil from soil blowing and to conserve soil moisture for plant growth.

Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable. Other practices that can be used to conserve soil moisture and reduce soil blowing include stubble-mulch tillage, limiting tillage for seedbed preparation and weed control, and stripcropping.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitations are the low available water capacity and the moderate hazard of soil blowing.

Sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Furrow, border, and corrugation systems are also suited to this unit. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and increasing the risk of erosion or leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses.

The potential plant community on this unit is mainly basin wildrye, needleandthread, and big sagebrush. The production of forage is limited by the low rainfall. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing and the low annual precipitation. Establishment of seedlings may be difficult because of these limitations. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for hay and pasture, the main limitations are the moderate hazard of soil blowing and the low available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water.

If this unit is used for windbreaks and environmental plantings, the main limitations are the low rainfall and the moderate hazard of soil blowing. If irrigation is used, most climatically adapted trees and shrubs can be grown. Among the trees that are suitable for planting are Rocky Mountain juniper and Lombardy poplar. Among the shrubs is caragana.

If this unit is used for homesite development, the main limitations are the low annual precipitation, the moderate hazard of soil blowing, and the hazard of flooding.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this problem.

44D—Klicker silt loam, 2 to 20 percent slopes. This moderately deep, well drained soil is on plateaus of the Blue Mountains. It formed in residuum mixed with loess. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 17 to 40 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown silt loam about 7 inches thick. The subsoil is dark

brown very cobbly silty clay loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Albee, Anatone, Bocker, and Tolo soils. Also included are small areas of soils that are similar to this Klicker soil but have less than 35 percent rock fragments and Klicker soils that have slopes of 20 to 40 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Klicker soil is moderately slow. Available water capacity is about 2.5 to 7.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of ponderosa pine. Other species that grow on this unit include Douglas-fir. The understory is mainly elk sedge, pinegrass, common snowberry, and serviceberry.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 76. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 51 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 63 cubic feet per acre.

The main limitations for the management of timber are the high content of rock fragments in the soil and the hazards of compaction and erosion.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted. Undesirable plants limit natural or artificial reforestation; however, intensive site preparation and maintenance generally are not needed.

Because roots are restricted by bedrock, trees are subject to windthrow.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

45E—Klicker very stony silt loam, 20 to 40 percent slopes. This moderately deep, well drained soil is on south- and east-facing hillslopes of the Blue Mountains. It formed in residuum mixed with loess. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 17 to 40 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown very stony silt loam about 7 inches thick. The subsoil is dark brown very cobbly silty clay loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Albee, Anatone, Bocker, Kahler, Tolo, and Umatilla soils. Also included are small areas of Klicker soils that have slopes of 2 to 20 percent or 40 to 70 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Klicker soil is moderately slow. Available water capacity is about 2.5 to 7.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of ponderosa pine. Other species that grow on this unit include Douglas-fir. The understory is mainly serviceberry, elk sedge, and pinegrass.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 76. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 51 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-

year-old trees 0.6 inch or larger in diameter at breast height is 63 cubic feet per acre.

The main limitations for the management of timber are the hazard of compaction and erosion, the high content of rock fragments in the soil, and the steepness of slope.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods. In the more steeply sloping areas, road location is more difficult and maintenance costs are greater.

Natural reforestation of harvested areas by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted. Undesirable plants limit adequate natural or artificial reforestation; however, intensive site preparation and maintenance generally are not needed.

Because roots are restricted by bedrock, trees on this unit are subject to windthrow.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, seeding of grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

46C—Klicker-Anatone-Bocker complex, 2 to 15 percent slopes. This map unit is on plateaus of the Blue Mountains. Elevation is 3,300 to 5,000 feet. The average annual precipitation is 18 to 35 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 50 percent Klicker silt loam, 25 percent Anatone very cobbly loam, and 15 percent Bocker very cobbly silt loam. The percentage varies from one area to another.

Included in this unit are small areas of Albee soils. Also included are small areas of Klicker, Anatone, and Bocker soils that have slopes of 15 to 35 percent and Bocker soils that have a stony surface layer. Included areas make up about 10 percent of the total acreage.

The Klicker soil is moderately deep and well drained. It formed in residuum mixed with loess. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown silt loam about 7 inches thick. The subsoil is dark brown very cobbly silty clay loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Klicker soil is moderately slow. Available water capacity is about 2.5 to 7.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Anatone soil is shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is dark brown very cobbly silt loam about 5 inches thick. The subsoil is dark brown extremely cobbly loam about 7 inches thick. Basalt is at a depth of 12 inches. Depth to basalt ranges from 10 to 20 inches. In some areas the surface layer is stony.

Permeability of the Anatone soil is moderate. Available water capacity is about 1.0 inch to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Bocker soil is very shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is brown very cobbly silt loam about 4 inches thick. The subsoil is brown very cobbly silt loam about 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 10 inches. In some areas the surface layer is stony.

Permeability of the Bocker soil is moderate. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 4 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production, livestock grazing, and wildlife habitat.

The Klicker soil is suited to the production of ponderosa pine. Other species that grow on this soil

include Douglas-fir. The understory is mainly serviceberry, elk sedge, and western fescue.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 76 on the Klicker soil. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 51 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 63 cubic feet per acre.

The main limitations for the management of timber are the high content of rock fragments in the soil and the hazards of compaction and erosion.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas of the Klicker soil by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted. Undesirable plants limit natural or artificial reforestation; however, intensive site preparation and maintenance generally are not needed.

Because roots are restricted by bedrock, trees on the Klicker soil are subject to windthrow.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

The potential plant community on the Anatone and Bocker soils is Sandberg bluegrass and bluebunch wheatgrass.

The production of forage on this unit is limited by the high content of rock fragments and the shallow depth to bedrock in the Anatone and Bocker soils. If the woodland understory or rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

46E—Klicker-Anatone-Bocker complex, 15 to 35 percent slopes. This map unit is on south- and east-facing hillslopes of the Blue Mountains. Elevation is 3,300 to 5,000 feet. The average annual precipitation is 18 to 35 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 45 percent Klicker silt loam, 25 percent Anatone very cobbly loam, and 20 percent Bocker very cobbly silt loam. The percentage varies from one area to another.

Included in this unit are small areas of Albee, Tolo, Kahler, and Umatilla soils. Also included are small areas of Klicker, Anatone, and Bocker soils that have slopes of 2 to 15 percent or 35 to 60 percent. Included areas make up about 10 percent of the total acreage.

The Klicker soil is moderately deep and well drained. It formed in residuum mixed with loess. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown silt loam about 7 inches thick. The subsoil is dark brown very cobbly silty clay loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Klicker soil is moderately slow. Available water capacity is about 2.5 to 7.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Anatone soil is shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is dark brown very cobbly silt loam about 5 inches thick. The subsoil is dark brown extremely cobbly loam about 7 inches thick. Basalt is at a depth of 12 inches. Depth to basalt ranges from 10 to 20 inches. In some areas the surface layer is stony.

Permeability of the Anatone soil is moderate. Available water capacity is about 1.0 inch to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Bocker soil is very shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is brown very cobbly silt loam about 4 inches thick. The subsoil is brown very cobbly silt loam about 3 inches thick. Basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 10 inches. In some areas the surface layer is stony.

Permeability of the Bocker soil is moderate. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 4 to 10 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

The Klicker soil is suited to the production of ponderosa pine. Other species that grow on this soil include Douglas-fir. The understory is mainly common serviceberry, elk sedge, and western fescue.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 76 on the Klicker soil. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 51 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 63 cubic feet per acre.

The main limitations for the management of timber are the high content of rock fragments in the soil, the hazards of compaction and erosion, and steepness of slope.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity.

In the more steeply sloping areas, road location is more difficult and maintenance costs are greater. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas of the Klicker soil by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted.

Undesirable plants limit natural or artificial reforestation; however, intensive site preparation and maintenance generally are not needed.

Because roots are restricted by bedrock, trees on the Klicker soil are moderately subject to windthrow.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

The potential plant community on the Anatone and Bocker soils is Sandberg bluegrass and bluebunch wheatgrass.

The production of forage on this unit is limited by the high content of rock fragments and the shallow depth to bedrock of the Anatone and Bocker soils. If the woodland understory or rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

47B—Koehler loamy fine sand, 0 to 5 percent slopes. This moderately deep, somewhat excessively drained soil is on strath terraces of the Columbia River. It formed in eolian sand deposited over cemented alluvium. Elevation is 450 to 700 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown loamy fine sand about 11 inches thick. The substratum is grayish brown loamy fine sand about 13 inches thick over a hardpan. A hardpan is at a depth of 24 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is fine sand.

Included in this unit are small areas of Quincy soils and Dune land. Also included are small areas of Koehler soils that have slopes of 5 to 10 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Koehler soil is rapid to a depth of 24 inches and very slow below this depth. Available water capacity is about 2 to 4 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Most areas of this unit are used for irrigated crops such as Irish potatoes, small grain, and alfalfa hay. Among the other crops grown are corn for grain and silage and asparagus. Some areas are used for pasture, homesite development, and rangeland.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, the high hazard of soil blowing,

low available water capacity, and the presence of a hardpan.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and developing a perched water table, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and Peking cotoneaster.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients or to avoid developing a perched water table.

The potential plant community on this unit is mainly needleandthread and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to minimize soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the high hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall, the high hazard of soil blowing, and the very slow permeability of the hardpan.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

The very slow permeability of the hardpan increases the possibility of failure of septic tank absorption fields.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. It is difficult to establish plants in areas where the surface layer has been removed, exposing the hardpan. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

48E—Lickskillet very stony loam, 7 to 40 percent slopes. This shallow, well drained soil is on hillslopes. It formed in colluvium and loess. Slopes are convex and generally are south- or west-facing. Elevation is 1,000 to 3,100 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 110 to 165 days.

Typically, 1 to 5 percent of the surface is covered with stones. The surface layer is dark grayish brown very stony loam about 6 inches thick. The subsoil is brown very gravelly loam about 12 inches thick. Basalt is at a depth of 18 inches. Depth to basalt ranges from 12 to 20 inches.

Included in this unit are small areas of Anderly, Bakeoven, Cantala, Condon, and Morrow soils and deep and moderately deep soils that have a high content of rock fragments. Also included are small areas of Rock outcrop and Lickskillet soils that have slopes of 40 to 70 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Lickskillet soil is moderate. Available water capacity is about 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the high content of rock fragments in the soil and the shallow depth to bedrock.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface is stony and the slopes are steep.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

49F—Lickskillet-Nansene association, 35 to 70 percent slopes. This map unit is on hillslopes. Elevation is 1,000 to 2,000 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 48 to 52 degrees F, and the average frost-free period is 140 to 165 days.

This unit is 40 percent Lickskillet very stony loam and 25 percent Nansene silt loam. The percentage varies from one area to another.

Included in this unit are small areas of Bakeoven, Condon, Mikkalo, and Wrentham soils and areas of Rock outcrop. Also included are small areas of deep soils that have more than 35 percent rock fragments and Lickskillet and Nansene soils that have slopes of 15 to 35 percent. Included areas make up about 35 percent of the total acreage.

The Lickskillet soil is shallow and well drained. It formed in colluvium and loess on south- and west-facing slopes. Typically, 1 to 5 percent of the surface is covered with stones. The surface layer is dark grayish brown very stony loam about 6 inches thick. The subsoil is brown very gravelly loam about 12 inches thick. Basalt is at a depth of 18 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Lickskillet soil is moderate. Available water capacity is about 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Nansene soil is deep and well drained. It formed in loess on north- and east-facing slopes. Typically, the surface layer is brown silt loam about 12 inches thick. The subsurface layer is brown silt loam about 8 inches thick. The subsoil is brown silt loam about 15 inches thick. The substratum to a depth of 60 inches or more is brown silt loam. In some areas the surface layer is fine sandy loam or very fine sandy loam. In some areas depth to basalt ranges from 40 to 60 inches.

Permeability of the Nansene soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Lickskillet soil is mainly bluebunch wheatgrass and Sandberg bluegrass. The potential plant community on the Nansene soil is mainly Idaho fescue and bluebunch wheatgrass. The production of forage is limited by the high content of rock fragments and shallow depth to bedrock in the Lickskillet soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface of the Lickskillet soil is stony and the slopes are steep.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

50F—Lickskillet-Rock outcrop complex, 40 to 70 percent slopes. This map unit is on hillslopes. Slopes are convex and generally are south- or west-facing. Elevation is 1,000 to 3,100 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 110 to 165 days.

This unit is 55 percent Lickskillet very stony loam and 15 percent Rock outcrop. The percentage varies from one area to another.

Included in this unit are small areas of Anderly, Bakeoven, Cantala, Condon, and Morrow soils and deep and moderately deep soils that have a high content of rock fragments. Also included are small areas of Lickskillet soils that have slopes of 7 to 40 percent. Included areas make up about 30 percent of the total acreage.

The Lickskillet soil is shallow and well drained. It formed in colluvium and loess. Typically, 1 to 5 percent of the surface is covered with stones. The surface layer is dark grayish brown extremely stony loam about 6 inches thick. The subsoil is brown very gravelly loam about 12 inches thick. Basalt is at a depth of 18 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Lickskillet soil is moderate. Available water capacity is about 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of areas of exposed basalt.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the high content of rock fragments in the soil and the shallow depth to bedrock.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface is stony and the slopes are steep.

Steepness of slope and rock outcroppings limit access by livestock and promote overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

51A—McKay silt loam, 0 to 7 percent slopes. This deep, well drained soil is in depressional areas on basin floors. It formed in old alluvium mixed with loess. Elevation is 1,450 to 1,900 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 48 to 52 degrees F, and the average frost-free period is 140 to 160 days.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The upper 6 inches of the subsoil is brown silty clay loam, and the lower 5 inches is yellowish brown silty clay loam. The upper 14 inches of the substratum is yellowish brown gravelly silt loam, the next 8 inches is brown gravelly silty clay loam, and the lower part to a depth of 60 inches or more is white gravelly loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Gurdane, Hermiston, and Pilot Rock soils. Also included are small areas of soils that are similar to this McKay soils but have 35 to 50 percent clay in the subsoil and McKay soils that have slopes of 7 to 15 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this McKay soil is slow. Available water capacity is about 8.5 to 12.5 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for nonirrigated small grain and pasture. It is also used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the silty clay loam subsoil, which restricts the movement of roots and water. A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable to include in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Subsoiling opens up the soil and allows water and salts to pass through. This reduces damage to crops as a result of the accumulation of salt and water erosion. It also increases the effective rooting depth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

52D—McKay silt loam, 7 to 25 percent north slopes. This deep, well drained soil is on toe slopes. It formed in loess, alluvium, and colluvium. Elevation is 1,500 to 2,600 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 46 to 49 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The upper 6 inches of the subsoil is brown silty clay loam, and the lower 5 inches is yellowish brown silty clay loam. The upper 14

inches of the substratum is yellowish brown gravelly silt loam, the next 8 inches is brown gravelly silty clay loam, and the lower part to a depth of 60 inches or more is pink to gravelly loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Gurdane, Gwinly, Morrow, Pilot Rock, and Palouse soils. Also included are small areas of soils that are similar to this McKay soil but that have slopes of 1 to 7 percent or 25 to 40 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this McKay soil is slow. Available water capacity is about 8.5 to 12.5 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for nonirrigated small grain and pasture. It is also used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for hay and pasture, the main limitation is the high hazard of water erosion.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

53D—McKay silt loam, 7 to 25 percent south slopes. This deep, well drained soil is on toe slopes. It formed in loess, alluvium, and colluvium. Elevation is 1,500 to 2,600 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 46 to 49 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The upper 6 inches of the subsoil is brown silty clay loam, and the lower 5 inches is yellowish brown silty clay loam. The upper 14 inches of the substratum is yellowish brown gravelly silt loam, the next 8 inches is brown gravelly silty clay loam, and the lower part to a depth of 60 inches or more is white gravelly loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Lickskillet and Morrow soils. Also included are small areas of soils that are similar to this McKay soil but that have bedrock at depth of 20 to 60 inches and McKay soils that have slopes of 1 to 7 percent or 25 to 40 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this McKay soil is slow. Available water capacity is about 8.5 to 12.5 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and pasture.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the steepness of slope and the included areas of shallow, stony soils that may restrict the use of equipment. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

If this unit is used for hay and pasture, the main limitation is the included areas of shallow, stony soils. Because this limitation will result in lower yields and higher production costs, areas that have a high percentage of included stony soils should be avoided when selecting areas to use for hay and pasture.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

54B—Mikkalo silt loam, 2 to 7 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 900 to 1,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 15 inches thick. Basalt is at a depth of 22 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Ritzville and Willis soils. Also included are small areas of Mikkalo soils that have slopes of 7 to 12 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Mikkalo soil is moderate. Available water capacity is about 3.5 to 8.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for nonirrigated small grain, rangeland, and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to bedrock, the moderate hazard of water erosion, and the moderate hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Terraces reduce gully erosion and conserve soil moisture. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling and subsoiling can be used to break up the pan. Other practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Scotch pine, and caragana.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

54C—Mikkalo silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess. Slopes face south and west. Elevation is 900 to 1,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 15 inches thick. Basalt is at a depth of 22 inches. Depth

to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Ritzville and Willis soils. Also included are small areas of Mikkalo soils that have slopes of 2 to 7 percent or 12 to 20 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Mikkalo soil is moderate. Available water capacity is about 3.5 to 8.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for nonirrigated small grain and as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to bedrock and the hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tilling and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Terraces reduce gully erosion and conserve soil moisture. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Other practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Scotch pine, and caragana.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture on this unit, reduce the distance between terraces and leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

54D—Mikkalo silt loam, 12 to 20 percent slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess. Slopes face south and west. Elevation is 900 to 1,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 15 inches thick. Basalt is at a depth of 22 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Lickskillet, Ritzville, and Willis soils. Also included are small areas of Mikkalo soils that have slopes of 7 to 12 percent or 20 to 40 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Mikkalo soil is moderate. Available water capacity is about 3.5 to 8.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred

forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to bedrock, the high hazard of water erosion, and the moderate hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Other practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Scotch pine, and caragana.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. To reduce erosion and increase conservation of soil moisture on this unit, leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulphur fertilizer.

54E—Mikkalo silt loam, 20 to 35 percent slopes. This moderately deep, well drained soil is on south- and west-facing hillslopes. It formed in loess. Elevation is 900 to 1,800 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 15 inches thick. Basalt is at a depth of 22 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Lickskillet, Ritzville, and Willis soils. Also included are small areas of Rock outcrop and Mikkalo soils that have slopes of 12 to 20 percent or 35 to 50 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Mikkalo soil is moderate. Available water capacity is about 3.5 to 8.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Slope may limit the use of mechanical treatment practices on the steeper parts of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

If this unit is used for nonirrigated crops, it is limited by the high hazard of water erosion and slope. A cropping system that includes small grain and summer fallow is

most suitable because precipitation is not sufficient for annual cropping; however, because of the steepness of slope and the high hazard of water erosion, the more steeply sloping areas of this unit should be planted to permanent vegetation.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

55A—Mondovi silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in silty alluvium. Elevation is 1,500 to 2,800 feet. The average annual precipitation is 5 to 20 inches, the average annual air temperature is 50 to 52 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the upper part of the surface layer is dark grayish brown silt loam about 12 inches thick and the lower part is dark grayish brown silt loam about 24 inches thick. The subsoil to a depth of 60 inches or more is dark grayish brown silt loam.

Included in this unit are small areas of Veazie soils and Xerofluvents. Also included are small areas of soils that are calcareous within the profile, ash pockets, and Riverwash. Included areas make up about 20 percent of the total acreage.

Permeability of this Mondovi soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this unit are used for nonirrigated small grain, hay, and pasture. A few areas are used for irrigated crops and as rangeland.

This unit is suited to nonirrigated crops. It has few limitations. The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Many areas are cropped annually; however, where precipitation is not sufficient for annual cropping, a system that includes small grain and summer fallow is more suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Other practices that can be used to conserve moisture include limiting tillage for seedbed preparation and weed control.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

This unit is suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Annual applications of nitrogen, phosphorous, and sulfur fertilizer are needed to maintain production of high quality irrigated pasture.

This unit is suited to irrigated crops. It has few limitations.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or peas. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly basin wildrye and basin big sagebrush.

56B—Morrow silt loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess, old alluvium, and residuum. Elevation is 2,000 to 3,100 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown silty clay loam about 5 inches thick. The substratum is brown silt loam and silty clay loam about 12 inches thick. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Bakeoven and Lickskillet soils. Also included are small areas of soils that are similar to this Morrow soil but have 15 to 50 percent rock fragments and Morrow soils that have

slopes of 7 to 12 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Morrow soil is moderately slow. Available water capacity is about 4.0 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for nonirrigated small grain. It is also used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

56C—Morrow silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on broad summits of hills. It formed in loess, old alluvium, and residuum. The native vegetation in areas not cultivated is mainly grasses, shrubs, and forbs. Elevation is 2,000 to 3,100 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown silty clay loam about 5 inches thick. The substratum is brown silt loam and silty clay loam about 12 inches thick. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Bakeoven, Cantala, and Lickskillet soils. Also included are small areas of soils that are similar to this Morrow soil but have 15 to 50 percent rock fragments and Morrow soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Morrow soil is moderately slow. Available water capacity is about 4.0 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for nonirrigated small grain. It is also used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to bedrock and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of

preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

56E—Morrow silt loam, 20 to 35 percent slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess, old alluvium, and residuum. Slopes are north- and east-facing. Elevation is 2,000 to 3,100 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown silty clay loam about 5 inches thick. The substratum is brown silt loam and silty clay loam about 12 inches thick. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Cantala, Lickskillet, and Wrentham soils. Also included are small areas of Morrow soils that have slopes of 12 to 20 percent or 35 to 60 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Morrow soil is moderately slow. Available water capacity is about 4.0 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper areas of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

If this unit is used for nonirrigated crops, the main limitations are moderate depth to bedrock and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping; however, because of the steepness of slope and high hazard of water erosion, the more steeply sloping areas of this unit should be planted to permanent vegetation.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. To reduce erosion and increase conservation of soil moisture on this unit, leave more crop residue on the surface.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

57D—Morrow silt loam, 12 to 20 percent north slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess, old alluvium, and residuum. Elevation is 2,000 to 3,100 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown silty clay loam about 5 inches thick. The substratum is brown silt loam and silty clay loam about 12 inches thick. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Cantala and Lickskillet soils. Also included are areas of soils that are similar to this Morrow soil but have bedrock at a depth of 40 to 60 inches and Morrow soils that have slopes of 1 to 12 percent or 20 to 30 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Morrow soil is moderately slow. Available water capacity is about 4.0 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat. It is also used for nonirrigated small grain.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

If this unit is used for nonirrigated crops, the main limitations are moderate depth to bedrock and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope, gradient terraces rather than level ones may be necessary.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

58D—Morrow silt loam, 12 to 20 percent south slopes. This moderately deep, well drained soil is on hillslopes. It formed in loess, old alluvium, and residuum. Elevation is 2,000 to 3,100 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown silty clay loam about 5 inches thick. The substratum is brown silt loam and silty clay loam about 12 inches thick. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Bakeoven, Lickskillet, and Wrentham soils. Also included are areas of soils that are similar to this Morrow soil but have 15 to 50 percent rock fragments and Morrow soils that have slopes of 1 to 12 percent or 20 to 30 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Morrow soil is moderately slow. Available water capacity is about 4.0 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the steepness of slope and the high percentage of included soils that are shallow or very shallow. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

If this unit is used for nonirrigated crops, the main limitations are the high percentage of included soils that are shallow or very shallow, droughtiness, and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface

helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope and limited soil depth, gradient terraces rather than level ones may be necessary.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. Tillage may be hampered because of the included soils that are shallow or very shallow. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

59D—Morrow-Bakeoven complex, 2 to 20 percent slopes. This map unit is on broad summits of hills. Elevation is 2,000 to 3,100 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 150 days.

This unit is 45 percent Morrow silt loam and 30 percent Bakeoven very cobbly loam. The percentage varies from one area to another. The soils occur as patterned land, locally known as biscuit-scabland. The Bakeoven soil is in the form of scabland between and around the areas of the Morrow soil. The Morrow soil is in the form of circular mounds, or biscuits, that have a convex surface and are deepest in the center.

Included in this unit are small areas of Lickskillet soils and soils that are similar to this Morrow soil but have 15 to 50 percent rock fragments. Also included are small areas of Morrow and Bakeoven soils that have slopes of 20 to 30 percent. Included areas make up about 25 percent of the total acreage.

The Morrow soil is moderately deep and well drained. It formed in loess, old alluvium, and residuum. Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown silty clay loam about 5 inches thick. The substratum to a depth of 27 inches is brown silt loam and silty clay loam. Basalt is at a depth of 27 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Morrow soil is moderately slow. Available water capacity is about 4.0 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Bakeoven soil is very shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is brown very cobbly loam about 3 inches thick. The subsoil is brown very gravelly loam and very gravelly clay loam about 5 inches thick. Basalt is at a depth of 8 inches. Depth to basalt ranges from 4 to 12 inches.

Permeability of the Bakeoven soil is moderately slow. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 4 to 12 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Morrow soil is mainly Idaho fescue and bluebunch wheatgrass. The potential plant community on the Bakeoven soil is mainly Sandberg bluegrass. Stiff sagebrush is in some areas. The production of forage is limited by the high content of rock fragments and the very shallow depth of the Bakeoven soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding or other mechanical or chemical treatment is poor. The main limitation for treatment is the interspersed areas of the very shallow Bakeoven soil. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

60F—Nansene silt loam, 35 to 70 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess. Slopes are convex and generally are north- or east-facing. The native vegetation is mainly grasses, shrubs, and forbs. Elevation is 900 to 2,500 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 48 to 52 degrees F, and the average frost-free period is 140 to 170 days.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsurface layer is brown silt loam about 8 inches thick. The subsoil is brown silt loam about 15 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas the surface layer is fine sandy loam or very fine sandy loam. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Nansene soils that have slopes of 20 to 35 percent. Also included are small areas of Anderly, Condon, Lickskillet, and Mikkalo soils and areas of Rock outcrop. Included areas make up about 25 percent of the total acreage.

Permeability of this Nansene soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Use of mechanical treatment practices is not practical because steepness of slope.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

61A—Oliphant silt loam, 0 to 3 percent slopes. This deep, well drained soil is on terraces. It formed in loess that has been deposited over lacustrine sediment. Elevation is 800 to 1,500 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsoil is brown silt loam about 18 inches thick. The upper 26 inches of the substratum is light brownish gray and pale brown silt loam, and the lower part to a depth of 60 inches or more is light gray gravelly silt loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Oliphant, eroded, soils. Also included are small areas of Oliphant soils that have slopes of 3 to 12 percent. Included areas make up about 5 percent of the total acreage.

Permeability of this Oliphant soil is moderate. Available water capacity is about 11.0 to 13.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated crops such as small grain, peas, beans, asparagus, tree fruit, and onions. Among the other crops grown are nonirrigated small grain and peas. Some areas are used for homesite development and rangeland.

This unit is suited to irrigated crops. Sprinkler irrigation is a suitable method of applying water. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If furrow or corrugation irrigation systems are used in the more steeply sloping areas of this unit, runs should be on the contour or across the slope.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes peas, beans, and small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to nonirrigated crops. A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable for inclusion in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

61C—Oliphant silt loam, 3 to 12 percent slopes. This deep, well drained soil is on terraces. It formed in loess that has been deposited over lacustrine sediment. Elevation is 800 to 1,500 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsoil is brown silt loam about 18 inches thick. The upper 26 inches of the substratum is light brownish gray and pale brown silt loam, and the lower part to a depth of 60 inches or more is light gray gravelly silt loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Oliphant, eroded, soils. Also included are small areas of Oliphant soils that have slopes of 0 to 3 percent or 12 to 20 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Oliphant soil is moderate. Available water capacity is about 11.0 to 13.5 inches. Effective

rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for irrigated crops and rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion. A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable to include in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitations are slope and the moderate hazard of water erosion. Sprinkler irrigation is a suitable method of applying water. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes peas, beans, and small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

62C—Oliphant silt loam, 3 to 25 percent slopes, eroded. This deep, well drained soil is on terraces and terrace scarps. It formed in loess that has been deposited over lacustrine sediment. Slopes face south and west. Elevation is 800 to 1,500 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is silt loam about 10 inches thick. The subsoil is brown silt loam 30 inches thick. The substratum to a depth of 60 inches or more is light gray gravelly silt loam. Depth to basalt is 60 inches or more.

Included in this unit are small areas of Oliphant soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Oliphant soil is moderate. Available water capacity is about 11.0 to 13.5 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated and nonirrigated crops and as rangeland.

If this unit is used for irrigated crops, the main limitations are slope and the high hazard of water erosion. Because of slope, sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes peas, beans, and small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to nonirrigated crops. It is limited by the high hazard of water erosion. The unit is suited to a grain-fallow cropping system; however, precipitation may be adequate to permit annual cropping for 2 to 3 years followed by 1 year of fallow. Winter and spring grain and peas are suitable crops to include in the cropping system. Areas that are severely eroded should be planted to permanent grass or grass-legume mixtures. Proper management practices help to improve tilth, the organic matter content, and the infiltration rate, which results in higher crop yields and reduced erosion.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface

helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass.

63A—Onyx silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in silty alluvium. Elevation is 800 to 1,800 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 48 to 52 degrees F, and the average frost-free period is 140 to 170 days.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The upper 8 inches of the subsoil is dark grayish brown silt loam, and the lower 10 inches is brown coarse silt loam. The substratum to a depth of 60 inches or more is brown silt loam. In some areas the surface layer is very fine sandy loam and fine sandy loam.

Included in this unit are small areas of Hermiston, Pedigo, and Yakima soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Onyx soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this unit are used for irrigated and nonirrigated crops, mainly small grain and alfalfa hay. A few areas are used for pasture, row crops, rangeland, and homesite development.

This unit is suited to irrigated crops. It has few limitations.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to nonirrigated crops. Many areas are cropped annually. In areas where precipitation is not sufficient for annual cropping, however, a system that includes small grain and summer fallow is more suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Other practices that can be used to conserve moisture include limiting tillage for seedbed preparation and weed control. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

This unit is suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen, phosphorous, and sulfur fertilizer are needed to maintain production of high quality irrigated pasture.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this limitation.

The potential plant community on this unit is mainly basin wildrye and basin big sagebrush.

64B—Palouse silt loam, 1 to 7 percent slopes. This deep, well drained soil is on summits of hills. It formed in loess. Elevation is 1,600 to 3,300 feet. The average annual precipitation is 18 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The subsurface layer is dark grayish brown silt loam about 13 inches thick. The subsoil is brown and light yellowish brown silt loam about 35 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Waha soils. Also included are small areas of Palouse soils that have slopes of 7 to 12 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Palouse soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated crops. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops and is cropped annually using a small grain-pea rotation. It is limited by the moderate hazard of water erosion.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, hawthorn, and chokecherry.

64C—Palouse silt loam, 7 to 12 percent slopes. This deep, well drained soil is on summits of hills. It formed in loess. Elevation is 1,600 to 3,300 feet. The average annual precipitation is 18 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The subsurface layer is dark grayish brown silt loam about 13 inches thick. The subsoil is brown and light yellowish brown silt loam about 35 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Waha soils. Also included are small areas of Palouse soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Palouse soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated crops. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops and is cropped annually using a small grain-pea rotation. It is limited by the moderate hazard of water erosion.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, hawthorn, and chokecherry.

64D—Palouse silt loam, 12 to 20 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess. Slopes are north- and east-facing. The native vegetation in areas not cultivated is mainly grasses, shrubs, and forbs. Elevation is 1,600 to 3,300 feet. The average annual precipitation is 18 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The subsurface layer is dark grayish brown silt loam about 13 inches thick. The subsoil is brown and light yellowish brown silt loam about 35 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Waha soils. Also included are small areas of Palouse soils that have slopes of 7 to 12 percent or 20 to 40 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Palouse soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for nonirrigated crops. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops and is cropped annually using a small grain-pea rotation. It is limited by the high hazard of water erosion.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue, hawthorn, snowberry, and chokecherry. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

64E—Palouse silt loam, 20 to 35 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess. Slopes are north- and east-facing. Elevation is 1,600 to 3,300 feet. The average annual precipitation is 18 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The subsurface layer is dark grayish brown silt loam about 13 inches thick. The subsoil is brown and light yellowish brown silt loam about 35 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Buckcreek, Gwinly, and Waha soils. Also included are small areas of Palouse soils that have slopes of 12 to 20 percent or 35 to 60 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Palouse soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue, hawthorn, snowberry, and chokecherry. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper areas of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some areas to encourage livestock to graze in areas where access is limited.

65A—Pedigo loamy fine sand, 0 to 3 percent slopes. This deep, somewhat poorly drained soil is on flood plains. It formed in silty alluvium. Elevation is 500 to 800 feet. The average annual precipitation is 10 to 11 inches, the average annual air temperature is 52 to 53 degrees F, and the average frost-free period is 160 to 180 days.

Typically, the surface layer is dark grayish brown loamy fine sand about 6 inches thick. The subsurface layer is dark grayish brown fine sand about 6 inches thick. Below this is a buried surface layer of dark brown silt loam about 9 inches thick. The substratum to a depth of 60 inches or more is grayish brown silt loam. In some areas the surface layer is silt loam or fine sandy loam.

Included in this unit are small areas of Adkins, wet, soils and Quincy and Wanser soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Pedigo soil is rapid to a depth of 12 inches and moderate below this depth. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more for water-tolerant plants but is limited to depths between 30 and 42 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 30 and 42 inches in winter and spring. This soil is subject to rare periods of flooding. The hazard of soil blowing is high. The soil contains large amounts of sodium.

This unit is used for irrigated alfalfa hay, pasture, and rangeland. It is limited mainly by wetness, excess sodium, and the high hazard of soil blowing.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the water table. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting. Tile or open drains can be used to remove excess water and provide an outlet for leached salts. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

The soil in this unit has a water table during the early part of the growing season and is subirrigated in many areas. If supplemental irrigation is necessary, sprinkler and flood systems are suitable. To avoid overirrigating and raising the water table, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. Among the trees and shrubs that are suitable for windbreaks are Russian-olive, Rocky Mountain juniper, and caragana.

The potential plant community on this unit is mainly basin wildrye and inland saltgrass.

66A—Pedigo silt loam, 0 to 3 percent slopes. This deep, somewhat poorly drained soil is on flood plains. It formed in silty alluvium. Elevation is 500 to 1,800 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 180 days.

Typically, the surface layer is dark grayish brown silt loam about 21 inches thick. The substratum to a depth of 60 inches or more is dark grayish brown silt loam.

Included in this unit are small areas of Adkins, wet, soils and Powder, Umapine, and Wanser soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Pedigo soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more for water-tolerant plants but is limited to depths between 30 and 42 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 30 and 42 inches in winter and spring. This soil is subject to rare periods of flooding. It contains large amounts of sodium.

Most areas of this unit are used for irrigated alfalfa hay and pasture. A few areas are used for irrigated and nonirrigated small grain and as rangeland.

This unit is suited to hay and pasture. The main limitations are wetness and excess sodium.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the water table. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting.

The soil in this unit has a water table during the early part of the growing season and is subirrigated in many areas. If supplemental irrigation is necessary, sprinkler and flood systems are suitable. To avoid overirrigating, raising the water table, and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

If this unit is used for irrigated small grain, the main limitations are the seasonal high water table and the excessive amount of salts in the soil.

Although the soil has a high content of toxic salts, particularly sodium, it can be used successfully to grow most climatically adapted crops if steps are taken to reduce the amount of salts present. Practices that can be used to reduce the content of salts include applying proper amounts of soil amendments, irrigating and leaching, growing salt-tolerant crops, and returning crop residue to the soil. Subsurface drains may be necessary in some areas to remove excess water and provide an outlet for leached salts.

Sprinkler irrigation is a suitable method of applying water. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or corn. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for nonirrigated small grain, areas in which the reaction and concentration of salts are lower are most suitable for planting.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth. Many areas are cropped annually. In areas where precipitation is not sufficient for annual cropping, a system that includes small grain and summer fallow is more suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Other practices that can be used to conserve moisture include limiting tillage for seedbed preparation and weed control. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly basin wildrye and inland saltgrass.

67B—Pilot Rock silt loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess overlying cemented alluvium. Elevation is 1,100 to 2,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 140 to 165 days.

Typically, the surface layer is grayish brown and brown silt loam about 10 inches thick. The subsoil is brown silt loam about 17 inches thick. Below this to a depth of 45 inches or more is a cemented hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Anderly soils, Entic Durochrepts, Vitrandepts, and Walla Walla soils. Also included are small areas of Pilot Rock soils that have slopes of 7 to 12 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Pilot Rock soil is moderate to a depth of 27 inches and very slow through the hardpan. Available water capacity is about 4.0 to 9.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for irrigated crops such as alfalfa hay, small grain, and pasture. Some areas are used for homesite development, rangeland, and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to the hardpan and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitations are the moderate depth to the hardpan and the moderate hazard of water erosion.

Sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and developing a perched water table or increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

67C—Pilot Rock silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess overlying cemented alluvium. Elevation is 1,100 to 2,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 140 to 165 days.

Typically, the surface layer is grayish brown and brown silt loam about 10 inches thick. The subsoil is brown silt loam about 17 inches thick. Below this to a depth of 45

inches or more is a cemented hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Anderly soils, Entic Durochrepts, Vitrandepts, and Walla Walla soils. Also included are small areas of Pilot Rock soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Pilot Rock soil is moderate to a depth of 27 inches and very slow through the pan. Available water capacity is about 4.0 to 9.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for irrigated crops such as alfalfa hay, small grain, and pasture. Some areas are used for homesite development, rangeland, and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to the hardpan and the moderate hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitations are the moderate depth to the hardpan and the moderate hazard of water erosion.

Sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

68D—Pilot Rock silt loam, 12 to 20 percent north slopes. This moderately deep, well drained soil is on terraces and terrace scarps. It formed in loess overlying cemented alluvium. Elevation is 1,100 to 2,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 140 to 165 days.

Typically, the surface layer is grayish brown and brown silt loam about 10 inches thick. The subsoil is brown silt loam about 17 inches thick. Below this to a depth of 45 inches or more is a cemented hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Anderly soils, Entic Durochrepts, and Walla Walla soils. Also included are small areas of Pilot Rock soils that have slopes of 7 to 12 percent or 20 to 40 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Pilot Rock soil is moderate to a depth of 27 inches and very slow through the pan. Available water capacity is about 4.0 to 9.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for nonirrigated small grain and rangeland. A few areas are used for wildlife habitat and homesite development.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to the hardpan and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of

soil moisture. Because of slope, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

68E—Pilot Rock silt loam, 20 to 35 percent north slopes. This moderately deep, well drained soil is on terrace scarps. It formed in loess overlying cemented alluvium. Elevation is 1,100 to 2,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 140 to 165 days.

Typically, the surface layer is grayish brown and brown silt loam about 10 inches thick. The subsoil is brown silt loam about 17 inches thick. Below this to a depth of 45 inches or more is a cemented hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Anderly soils, Entic Durochrepts, and Walla Walla soils. Also included are small areas of Pilot Rock soils that have slopes of 12 to 20 percent or 35 to 60 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Pilot Rock soil is moderate to a depth of 27 inches and very slow through the pan. Available water capacity is about 4.0 to 9.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for nonirrigated small grain, rangeland, and wildlife habitat.

Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping; however, because of the steepness of slope and high hazard of water erosion, the more steeply sloping areas of this unit should be planted to permanent vegetation.

If this unit is used for nonirrigated crops, it is limited by the moderate depth to the hardpan, slope, and the high hazard of water erosion. The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

69D—Pilot Rock silt loam, 12 to 20 percent south slopes. This moderately deep, well drained soil is on terraces and terrace scarps. It formed in loess overlying cemented alluvium. Elevation is 1,100 to 2,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 140 to 165 days.

Typically, the surface layer is grayish brown and brown silt loam about 10 inches thick. The subsoil is brown silt loam about 17 inches thick. Below this to a depth of 45 inches or more is a cemented hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Anderly soils, Entic Durochrepts, and Walla Walla soils. Also included are small areas of soils that are similar to this Pilot Rock soil but that have 15 to 50 percent rock fragments and Pilot Rock soils that have slopes of 7 to 12 percent or 20 to 40 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Pilot Rock soil is moderate to a depth of 27 inches and very slow through the pan. Available water capacity is about 4.0 to 9.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for nonirrigated small grain and rangeland. A few areas are used for wildlife habitat and homesite development.

This unit is suited to nonirrigated crops. It is limited mainly by the moderate depth to the hardpan, droughtiness, and the high hazard of water erosion. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope and limited soil depth, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope and areas of shallow included soils. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

69E—Pilot Rock silt loam, 20 to 30 percent south slopes. This moderately deep, well drained soil is on terrace scarps. It formed in loess overlying cemented alluvium. Elevation is 1,100 to 2,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 140 to 165 days.

Typically, the surface layer is grayish brown and brown silt loam about 10 inches thick. The subsoil is brown silt loam about 17 inches thick. Below this to a depth of 45 inches or more is a cemented hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Anderly soils, Entic Durochrepts, Lickskillet soils, and Walla Walla soils. Also included are small areas of Rock outcrop, soils that are similar to this Pilot Rock soil but that have 15 to 50 percent rock fragments, and Pilot Rock soils that have slopes of 12 to 20 percent or 30 to 60 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Pilot Rock soil is moderate to a depth of 27 inches and very slow through the pan. Available water capacity is about 4.0 to 9.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope and areas of shallow included soils. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

70—Pits, gravel. This map unit consists of excavated areas of waterworn gravel, commonly mixed with sand or other soil material. Most of these areas are being mined for sand and gravel and support little vegetation. The pits that are abandoned support vegetation only in those areas in which soil material has accumulated.

These areas occur within other units that consist of soils that have a gravelly substratum, such as the Quincy and Adkins soils. They also occur along the major drainageways within the survey area.

Since the areas of sand and gravel offer little support for vegetation, it is necessary to fill them with soil material in order to reclaim them.

71A—Potamus gravelly loam, 0 to 2 percent slopes. This deep, well drained soil is on terraces. It formed in mixed alluvium. Elevation is 3,300 to 3,500 feet. The average annual precipitation is 15 to 25 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 90 days.

Typically, the surface layer is very dark grayish brown gravelly loam about 4 inches thick. The subsurface layer is very dark gray gravelly clay loam about 11 inches thick. The subsoil is yellowish brown very gravelly clay loam about 30 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely gravelly clay loam. In some areas the surface layer has less than 15 percent rock fragments.

Included in this unit are small areas of Silvies soils, Xerofluvents, and Riverwash. Also included are small areas of deep loam that is less than 35 percent rock fragments. Included areas make up about 10 percent of the total acreage.

Permeability of this Potamus soil is moderate. Available water capacity is about 5.0 to 10.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for hay and pasture and as rangeland. It can be used for irrigated crops if water is available.

This unit is suited to hay and pasture. The main limitations are the high content of rock fragments in the soil and the short growing season.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Grasses and legumes adapted to a cool climate and short growing season are recommended. Fertilizer is needed to ensure optimum growth of grasses and legumes.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and prairie junegrass.

72A—Powder silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in silty alluvium. Elevation is 500 to 1,300 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 160 to 180 days.

Typically, the surface layer is grayish brown silt loam about 15 inches thick. The subsoil is dark grayish brown silt loam about 12 inches thick. The upper 30 inches of the substratum is grayish brown silt loam, and the lower part to a depth of 60 inches or more is gravel. In some areas gravel is at a depth of 20 to 50 inches. In some areas the surface layer is fine sandy loam or very fine sandy loam.

Included in this unit are small areas of Esquatzel and Pedigo soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Powder soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this unit are used for irrigated small grain and alfalfa hay. Among the other crops grown are corn for grain and silage. Some areas are used for pasture and as rangeland.

This unit is suited to irrigated crops. It has few limitations.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Poor irrigation water management can cause excessive amounts of salt to accumulate near the soil surface.

If gravity irrigation systems are used, leveling is needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 4 or 5

years of alfalfa hay and 3 or 4 years of small grain or corn. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water.

The potential plant community on this unit is mainly basin wildrye and basin big sagebrush.

73D—Prosser silt loam, 12 to 20 percent slopes. This moderately deep, well drained soil is on terrace scarps. It formed in loess. Slopes are convex and generally are south- and west-facing. Elevation is 650 to 1,200 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 52 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Burke, Lickskillet, and Shano soils and Rock outcrop. Also included are small areas of soils that are similar to this Prosser soil but have a hardpan or basalt at a depth of 40 to 60 inches and Prosser soils that have slopes of 5 to 12 percent or 20 to 40 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Prosser soil is moderate. Available water capacity is about 3 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. The production of forage is limited by the low natural fertility and low rainfall.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for nonirrigated crops, it is limited by the moderate depth to bedrock, the high hazard of water erosion, and the hazard of soil blowing. A cropping system that includes small grain and summer fallow is most suitable because precipitation is not sufficient for annual cropping.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Other practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping where feasible, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Scotch pine, and Tatarian honeysuckle.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

73E—Prosser silt loam, 20 to 40 percent slopes. This moderately deep, well drained soil is on terrace scarps. Slopes are convex and generally are south- and west-facing. The soil formed in loess. Elevation is 650 to 1,200 feet. The average annual precipitation is 8 to 10

inches, the average annual air temperature is 50 to 52 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Burke, Lickskillet, and Shano soils and areas of Rock outcrop. Also included are small areas of soils that are similar to this Prosser soil but have a hardpan or basalt at a depth of 40 to 60 inches and Prosser soils that have slopes of 12 to 20 percent or 40 to 50 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Prosser soil is moderate. Available water capacity is about 3 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. The production of forage is limited by low natural fertility and low rainfall.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

The suitability of this unit for rangeland seeding is poor. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may be limited in the steeper areas of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails and walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

74B—Quincy fine sand, 0 to 5 percent slopes. This deep, excessively drained soil is on strath terraces of the Columbia River. It formed in eolian sand. Elevation is 300 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown fine sand about 4 inches thick. The upper 23 inches of the substratum is grayish brown loamy fine sand, the next 12 inches is gray fine sand, and the lower part to a depth of 60 inches or more is light brownish gray fine sand. In some areas the surface layer is loamy fine sand or sand.

Included in this unit are small areas of Burbank soils, Dune land, and Wanser and Winchester soils. Also included are small areas of Quincy soils that have a gravelly substratum or have slopes of 5 to 20 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Quincy soil is rapid. Available water capacity is about 2.5 to 5.0 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Most areas of this unit are used for irrigated crops such as Irish potatoes, small grain, and corn for grain and silage. Among the other crops grown are alfalfa hay and watermelons. Some areas are used for pasture, for homesite development, and as rangeland.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, rapid permeability, and the very high hazard of soil blowing.

Because the water intake rate is high, sprinkler or drip irrigation is best suited to this unit. Center pivot systems are most commonly used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically

adapted trees and shrubs can be grown for windbreaks. These include Lombardy poplar, Rocky Mountain juniper, and Tatarian honeysuckle.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, and antelope bitterbrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the very high hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are the very high hazard of soil blowing, low rainfall, and rapid permeability.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

75B—Quincy loamy fine sand, 0 to 5 percent slopes. This deep, excessively drained soil is on strath terraces of the Columbia River. It formed in eolian sand. Elevation is 300 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown loamy fine sand about 4 inches thick. The upper 23 inches of the substratum is grayish brown loamy fine sand, the next 12 inches is gray fine sand, and the lower part to a depth of 60 inches or more is light brownish gray fine sand. In some areas the surface layer is fine sand or sand.

Included in this unit are small areas of Adkins, Burbank, and Quincy soils that have a gravelly substratum, Wanser soils, and Winchester soils. Also included are small areas of Quincy soils that have slopes of 5 to 25 percent and Dune land. Included areas make up about 15 percent of the total acreage.

Permeability of this Quincy soil is rapid. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Most areas of this unit are used for irrigated alfalfa hay, small grain, and Irish potatoes. Among the other crops grown are corn for grain and silage and watermelons. Some areas are used for pasture, rangeland, and urban or homesite development.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, rapid permeability, and the high hazard of soil blowing.

Because the water intake rate is high, sprinkler or drip irrigation is best suited to this unit. Center pivot systems are most commonly used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and

using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. These include Lombardy poplar, green ash, and Siberian peashrub.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the high hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are the high hazard of soil blowing, low rainfall, and rapid permeability.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

75E—Quincy loamy fine sand, 5 to 25 percent slopes. This deep, excessively drained soil is on strath terraces of the Columbia River. It formed in eolian sand. Elevation is 300 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown loamy fine sand about 4 inches thick. The upper 23 inches of the substratum is grayish brown loamy fine sand, the next 12 inches is gray fine sand, and the lower part to a depth of 60 inches or more is light brownish gray fine sand. In some areas the surface layer is fine sand or sand.

Included in this unit are small areas of Adkins soils, Quincy soils that have a gravelly substratum, and Winchester soils. Also included are small areas of Dune land, Rock outcrop, and Quincy soils that have slopes of 0 to 5 percent or 25 to 50 percent. Included areas make up about 35 percent of the total acreage.

Permeability of this Quincy soil is rapid. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Most areas of this unit are used as rangeland and for irrigated crops such as alfalfa hay, small grain, and Irish potatoes. Among the other crops grown are corn for grain and silage. Some areas are used for pasture and for recreational, urban, or homesite development.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, and antelope bitterbrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the high hazard of soil blowing, low rainfall, and slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, slope, and the high hazard of soil blowing.

Because of slow water intake rate and slope, sprinkler or drip irrigation is best suited to this unit. Center pivot systems are most commonly used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Because of the risk of excessive runoff, it is important to carefully manage irrigation water in the more steeply sloping areas of this unit.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. These include Austrian pine, Rocky Mountain juniper, and Peking cotoneaster.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

If this unit is used for homesite or recreational development, the main limitations are the high hazard of soil blowing, low rainfall, rapid permeability, and steepness of slope.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

76B—Quincy loamy fine sand, gravelly substratum, 0 to 5 percent slopes. This deep, excessively drained soil is on strath terraces of the Columbia River. It formed in gravelly alluvium mantled by eolian sand. Elevation is 300 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown loamy fine sand about 4 inches thick. The upper 23 inches of the substratum is grayish brown loamy fine sand, the next 14

inches is gray fine sand, and the lower part to a depth of 60 inches or more is light brownish gray very gravelly fine sand. Depth to the gravelly substratum ranges from 40 to 60 inches. In some areas the surface layer is fine sand.

Included in this unit are small areas of Burbank and Quincy soils that do not have a gravelly substratum and Wanser soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Quincy soil is rapid. Available water capacity is about 2.5 to 5.0 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Most areas of this unit are used for irrigated crops such as Irish potatoes, small grain, and corn for grain and silage. Among the other crops grown are alfalfa hay and watermelons. Some areas are used for pasture, for homesite development, and as rangeland.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, rapid permeability, and the high hazard of soil blowing.

Because the water intake rate is high, sprinkler or drip irrigation is best suited to this unit. Center pivot systems are most commonly used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. These include ponderosa pine, black locust, and lilac.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, and antelope bitterbrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the high hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are the high hazard of soil blowing, low rainfall, and rapid permeability.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

It is difficult to establish plants in areas where the surface layer has been removed, exposing the gravelly substratum. Mulching and fertilizing cut areas help to establish plants. In summer, irrigation is needed for lawn

grasses, shrubs, vines, shade trees, and ornamental trees.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability.

77C—Quincy loamy fine sand, 0 to 25 percent slopes, eroded. This deep, excessively drained soil is on strath terraces of the Columbia River. It formed in eolian sand. The native vegetation is mainly grasses, shrubs, and forbs. Elevation is 700 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown loamy fine sand about 4 inches thick. The upper 23 inches of the substratum is grayish brown loamy fine sand, the next 12 inches is gray fine sand, and the lower part to a depth of 60 inches or more is light brownish gray fine sand. In some areas the surface layer is fine sandy loam, fine sand, or sand.

Included in this unit are small areas of Adkins soils, Dune land, and Koehler, Quinton, Sagehill, Taunton, and Winchester soils. Also included are small areas of soils in which a hardpan or a calcareous silt loam substratum has been exposed. Included areas make up about 60 percent of the total acreage.

Permeability of this Quincy soil is rapid. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, and antelope bitterbrush. The production of forage is limited by low rainfall, low natural fertility, and soil blowing that has already occurred. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

Rangeland seeding is suitable if the rangeland is in poor condition. It is difficult to establish desirable rangeland grasses on this unit because of the very high hazard of soil blowing. Soil blowing can be minimized by seeding with permanent grasses and mulching. Suitable materials include straw, asphalt, jute netting, and gravel or a combination of these materials. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

78B—Quincy-Rock outcrop complex, 1 to 20 percent slopes. This map unit is on strath terraces along the Columbia River. Elevation is 350 to 1,100 feet. The average annual precipitation is about 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is 50 percent Quincy fine sand and 20 percent Rock outcrop. The percentage varies from one area to another.

Included in this unit are Quinton, Starbuck, and Winchester soils. Included areas make up about 30 percent of the total acreage.

The Quincy soil is deep and excessively drained. It formed in eolian sand. Typically, the surface layer is grayish brown fine sand about 4 inches thick. The upper 23 inches of the substratum is grayish brown loamy fine sand, the next 12 inches is gray fine sand, and the lower part to a depth of 60 inches or more is light brownish gray fine sand. In some areas the surface layer is loamy fine sand or sand. In some areas depth to basalt ranges from 40 to 60 inches.

Permeability of the Quincy soil is rapid. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Rock outcrop is jointed and fractured basalt on low ridges and low hills above the areas of Quincy soil. It commonly is barren or has scattered shrubs and grasses in pockets of soil material.

Most areas of this unit are used as rangeland and for wildlife habitat. A few areas are used for recreational development.

The potential plant community on this unit is mainly needleandthread and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly

if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to minimize soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is a suitable practice on this unit if the range vegetation is in poor condition. The main limitation for seeding is the areas of Rock outcrop. Seeding is not practical where individual areas of the Quincy soil are small or are very narrow. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for recreational development, the main limitations are the areas of Rock outcrop, the hazard of soil blowing, and slope.

When developing this unit for recreational purposes, the steeper areas and the areas of Rock outcrop should be avoided unless they are features to be highlighted in the development.

Soil blowing can be reduced by maintaining plant cover and by using windbreaks. If irrigation is used, most climatically adapted trees and shrubs can be grown. Among the trees and shrubs that are suitable for planting are Lombardy poplar, Scotch pine, and Tatarian honeysuckle.

Excavation for structures and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

79B—Ritzville very fine sandy loam, 2 to 7 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown very fine sandy loam about 8 inches thick. The subsoil is brown and pale brown very fine sandy loam and silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Adkins, Mikkalo, Quincy, Sagehill, and Willis soils. Also included are small areas of Ritzville soils that have slopes of 7 to 12 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, terraces are constructed, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Terraces reduce gully erosion and conserve soil moisture. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen and phosphorous fertilizer.

If this unit is used for irrigated crops, it is limited mainly by the availability of irrigation water and the moderate hazards of soil blowing and water erosion.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients or increasing the risk of water erosion, applications of irrigation water should be

adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping in nonirrigated areas, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and lilac.

The potential plant community on this unit is mainly needleandthread and bluebunch wheatgrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

79C—Ritzville very fine sandy loam, 7 to 12 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown very fine sandy loam about 8 inches thick. The subsoil is brown and pale brown very fine sandy loam and silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Adkins, Mikkalo, Quincy, Sagehill, and Willis soils. Also included are small areas of Ritzville soils that have slopes of 1 to 7 percent or 12 to 25 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, terraces are constructed, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Terraces reduce gully erosion and conserve soil moisture. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture, reduce the distance between terraces and leave residue on the surface.

Crops respond to nitrogen and phosphorous fertilizer.

If this unit is used for irrigated crops, it is limited mainly by the availability of irrigation water and the moderate hazards of soil blowing and water erosion.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and

minimizes the risk of erosion. To avoid overirrigating and increasing the risk of water erosion or leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping in nonirrigated areas, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are green ash, Austrian pine, and Siberian peashrub.

The potential plant community on this unit is mainly needleandthread and bluebunch wheatgrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

79D—Ritzville very fine sandy loam, 12 to 25 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown very fine sandy loam about 8 inches thick. The subsoil is brown and pale brown very fine sandy loam and silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silt loam or fine sandy loam.

Included in this unit are small areas of Adkins and Mikkalo soils and pockets of volcanic ash or sand. Also included are small areas of Ritzville soils that have slopes of 7 to 12 percent or 25 to 50 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly needleandthread and bluebunch wheatgrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

This unit is suited to nonirrigated crops. It is limited by the high hazard of water erosion and the moderate hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be

shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Other practices that can be used to reduce soil blowing are establishing windbreaks; stripcropping, where feasible; keeping the soil rough and cloddy when it is not protected by plant cover; and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Scotch pine, Rocky Mountain juniper, and Peking cotoneaster.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture, leave more crop residue on the surface.

Crops respond to nitrogen, sulfur, and phosphorous fertilizer.

79E—Ritzville very fine sandy loam, 25 to 50 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess. Slopes generally are south-facing. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown very fine sandy loam about 8 inches thick. The subsoil is brown and pale brown very fine sandy loam and silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silt loam or fine sandy loam.

Included in this unit are small areas of Lickskillet and Mikkalo soils and Rock outcrop. Also included are small areas of Ritzville soils that have slopes of 12 to 25 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

80B—Ritzville silt loam, 2 to 7 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and pale brown silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Mikkalo and Willis soils and Ritzville soils that have slopes of 7 to 12 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion and the hazard of soil blowing. Because precipitation is not sufficient for

annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, terraces are constructed, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Terraces reduce gully erosion and conserve soil moisture. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen and phosphorous fertilizer.

If this unit is used for irrigated crops, it is limited mainly by the availability of irrigation water and the moderate hazard of soil blowing.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating, leaching of plant nutrients, and increasing the risk of water erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping in nonirrigated areas, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and lilac.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

80C—Ritzville silt loam, 7 to 12 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and pale brown silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Mikkalo and Willis soils and Ritzville soils that have slopes of 2 to 7 percent or 12 to 25 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, terraces are constructed, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Terraces reduce gully erosion and conserve soil moisture. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture on this unit, reduce the distance between terraces and leave more residue on the surface.

Crops respond to nitrogen and phosphorous fertilizer.

If this unit is used for irrigated crops, the main limitations are the availability of irrigation water, slope, and the moderate hazards of soil blowing and water erosion.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating, leaching of plant nutrients, and increasing the risk of water erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes.

Other practices that reduce the hazard of soil blowing are planting windbreaks, growing winter cover crops, stripcropping in nonirrigated areas, keeping the soil rough and cloddy when it is not protected by plant cover, using minimum tillage, properly timing irrigation, and cultivating, planting, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are green ash, Austrian pine, and Siberian peashrub.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

80D—Ritzville silt loam, 12 to 25 percent slopes. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and pale brown silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Mikkalo and Willis soils and Ritzville soils that have slopes of 2 to 12 percent or 25 to 40 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the high hazard of water erosion and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture on this unit, leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, stripcropping, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. These include Scotch pine, Rocky Mountain juniper, and Peking cotoneaster.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

81E—Ritzville silt loam, 25 to 40 percent north slopes. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and pale brown silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam or fine sandy loam.

Included in this unit are small areas of Mikkalo soils, Rock outcrop, and pockets of volcanic ash. Also included are small areas of Ritzville soils that have slopes of 12 to 25 percent or 40 to 70 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

82E—Ritzville silt loam, 25 to 40 percent south slopes. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 900 to 1,900 feet. The average annual precipitation is 10 to 12 inches, the

average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is brown and pale brown silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Lickskillet and Mikkalo soils and Rock outcrop. Also included are small areas of Ritzville soils that have slopes of 12 to 25 percent or 40 to 70 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

83C—Ritzville-Rock outcrop complex, 0 to 25 percent slopes. This map unit is on strath terraces of the Columbia River. Elevation is 900 to 1,100 feet. The average annual precipitation is 9 to 10 inches, the average annual air temperature is 52 to 53 degrees F, and the average frost-free period is 160 to 170 days.

This unit is 75 percent Ritzville very fine sandy loam and 15 percent Rock outcrop. The percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Mikkalo and Starbuck soils. Also included are small areas of Rock outcrop and Ritzville soils that have slopes of more than 25 percent. Included areas make up about 10 percent of the total acreage.

The Ritzville soil is deep and well drained. It formed in loess. Typically, the surface layer is brown very fine sandy loam about 8 inches thick. The subsoil is brown and pale brown very fine sandy loam and silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas bedrock is at a depth of 40 to 60 inches.

Permeability of this Ritzville soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Rock outcrop consists of areas of exposed basalt.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. Slope and the areas of Rock outcrop are the main limitations. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

Steepness of slope and the areas of Rock outcrop limit access by livestock and promote overgrazing of the more readily accessible areas. Trails or walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

84—Riverwash. This map unit is on flood plains. It occurs as irregular strips along the Umatilla River and other drainageways (fig. 6). It formed in mixed alluvium. Slope is 0 to 3 percent. Riverwash supports little if any

vegetation. Elevation is 250 to 2,500 feet. The average annual precipitation is 8 to 25 inches, the average annual air temperature is 45 to 54 degrees F, and the average frost-free period is 100 to 190 days.

Most areas of Riverwash are very cobbly sand, extremely cobbly sand, or extremely gravelly sand to a depth of 60 inches or more.

Figure 6.—Nearly barren area of Riverwash in foreground. Xerofluvents, in center, support a wide variety of plants.

Included in this unit are small areas of Freewater, Veazie, and Yakima soils and Xerofluvents. The percentage varies from one area to another.

Permeability of Riverwash is rapid. Available water capacity is low. Runoff is slow, and the hazard of water erosion is slight. The areas of Riverwash are subject to flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

Most areas of this unit are used for wildlife habitat. A few areas are used as a source of sand and gravel.

85F—Rock outcrop-Xeric Torriorthents complex, 10 to 70 percent slopes. This map unit is on terrace scarps and foot slopes. Elevation is 300 to 1,200 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is about 50 percent Rock outcrop and 25 percent Xeric Torriorthents. The percentage varies from one area to another.

Included in this unit are small areas of Quinton, Quincy, Starbuck, and Winchester soils. Included areas make up about 25 percent of the total acreage.

Rock outcrop consists of areas of exposed basalt.

The Xeric Torriorthents are moderately deep to deep and are somewhat excessively drained to well drained. These soils formed in mixed eolian sand and colluvium. The surface layer ranges from fine sandy loam to silt loam. The substratum ranges from fine sandy loam to loamy fine sand and has 10 to 80 percent rock fragments. Depth to bedrock ranges from 20 inches to more than 60 inches.

Permeability and available water capacity of the Xeric Torriorthents are variable. Effective rooting depth is 20 inches to more than 60 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is high.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for recreational development.

The potential plant community on this unit varies; however, plants that may occur in the community include needleandthread, bluebunch wheatgrass, antelope bitterbrush, and Sandberg bluegrass. The production of forage is limited by the low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. In general, winter is the best season for grazing on this unit. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may not be practical in the steeper areas of this unit.

Rangeland seeding is a suitable practice in the less sloping areas of this unit if the range vegetation is in poor condition. The main limitations for seeding are the low rainfall, steepness of slope, and the hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

If this unit is used for recreational development, the main limitations are the large amount of Rock outcrop, the hazard of soil blowing, and slope.

When developing this unit for recreational purposes, areas of excessive slope and Rock outcrop should be avoided unless they are features to be highlighted in the development.

Soil blowing can be reduced by maintaining plant cover and by using windbreaks. If irrigation is used, most climatically adapted trees and shrubs can be grown. Among the trees that are suitable for planting are Lombardy poplar and green ash. Among the shrubs are lilac.

Excavation for structures and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible help to control soil blowing.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

86D—Rockly very cobbly loam, 2 to 20 percent slopes. This very shallow, well drained soil is on ridges in the foothills of the Blue Mountains. It formed in residuum mixed with loess. Elevation is 1,700 to 4,500 feet. The average annual precipitation is 16 to 30 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface layer is brown very cobbly loam about 2 inches thick. The subsoil is brown very cobbly

loam about 4 inches thick. Basalt is at a depth of 6 inches. Depth to basalt ranges from 5 to 12 inches. In some areas the surface layer is stony.

Included in this unit are small areas of Gurdane, Gwinly, and Waha soils. Also included are small areas of Rockly soils that have slopes of 20 to 30 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Rockly soil is moderately slow. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 5 to 12 inches. Runoff is medium, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Sandberg bluegrass and bluebunch wheatgrass. Stiff sagebrush is in some areas. The production of forage is limited by the high content of rock fragments in the soil and the very shallow depth to bedrock.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system. Use of mechanical treatment practices generally is not practical because of the very shallow depth to bedrock and the high content of rock fragments in the soil.

87B—Sagehill fine sandy loam, 2 to 5 percent slopes. This deep, well drained soil is on strath terraces of the Columbia River. It formed in eolian sand over lacustrine sediment. Elevation is 500 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is pale brown fine sandy loam about 8 inches thick. The subsoil is pale brown fine sandy loam about 12 inches thick. The upper 7 inches of the substratum is light brownish gray very fine sandy loam, and the lower part to a depth of 60 inches or more is light brownish gray silt loam. Depth to lacustrine sediment ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Adkins, Quincy, and Taunton soils. Also included are small areas of Sagehill soils that have slopes of 5 to 12 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Sagehill soil is moderately rapid to a depth of 27 inches and moderate below this depth. Available water capacity is about 10.5 to 12.0 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most areas of this unit are used for irrigated crops such as alfalfa hay, Irish potatoes, small grain, and corn for grain and silage. Among the other crops grown is nonirrigated small grain. Some areas are used for pasture, rangeland, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, the moderate hazard of soil blowing, and the moderate permeability of the substratum.

Sprinkler and drip irrigation are suitable methods of applying water. Center pivot irrigation systems are most commonly used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and developing a perched water table, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and lilac.

If this unit is used for nonirrigated crops, the main limitations are the moderate hazard of soil blowing and low rainfall. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control soil blowing. Other practices that can be used to control soil blowing and conserve moisture include seeding early in fall, performing minimum tillage, and stripcropping.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Border, corrugation, and sprinkler irrigation systems are suited to this unit. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall, the moderate hazard of soil blowing, and the moderate permeability of the substratum.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

The moderate permeability of the substratum increases the possibility of failure of septic tank absorption fields.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. It is difficult to establish plants in areas where the surface layer has been removed, exposing the substratum. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

87C—Sagehill fine sandy loam, 5 to 12 percent slopes. This deep, well drained soil is on strath terraces of the Columbia River. It formed in eolian sand deposited over lacustrine sediment. Elevation is 500 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is pale brown fine sandy loam about 8 inches thick. The subsoil is pale brown fine sandy loam about 12 inches thick. The upper 7 inches of the substratum is light brownish gray very fine sandy loam, and the lower part to a depth of 60 inches or more is light brownish gray silt loam. Depth to lacustrine sediment ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Adkins, Quincy, and Taunton soils. Also included are small areas of Sagehill soils that have slopes of 2 to 5 percent or 12 to 20 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Sagehill soil is moderately rapid to a depth of 27 inches and moderate below this depth. Available water capacity is about 10.5 to 12.0 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for irrigated crops such as alfalfa hay, Irish potatoes, small grain, and corn for grain and silage. Among the other crops grown is nonirrigated small grain. Some areas are used for pasture, rangeland, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, the moderate hazard of soil blowing, slope, and the moderate permeability of the substratum.

Because of slope, sprinkler or drip irrigation is best suited to this unit. Center pivot irrigation systems are most commonly used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and developing a perched water table, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces

runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and lilac.

If this unit is used for nonirrigated crops, the main limitations are the moderate hazard of soil blowing and low rainfall. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control soil blowing. Other practices that can be used to control soil blowing and conserve moisture include seeding early in fall, performing minimum tillage, and stripcropping.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, or excessive erosion.

Because of slope, sprinkler irrigation systems are suited to this unit. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall, the moderate hazard of soil blowing, the moderate permeability of the substratum, and slope.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed.

The moderate permeability of the substratum increases the possibility of failure of septic tank absorption fields. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. It is difficult to establish plants in areas where the surface layer has been removed, exposing the substratum. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

88B—Shano very fine sandy loam, 2 to 7 percent slopes. This deep, well drained soil is on terraces. It formed in loess deposited over lacustrine sediment. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown very fine sandy loam about 2 inches thick. The subsoil is pale brown coarse silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown silt loam. In some areas depth to basalt or a hardpan ranges from 40 to 60 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Adkins, Burke, Quincy, and Sagehill soils. Also included are small areas of Shano soils that have slopes of 7 to 12 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Shano soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

This unit is suited to irrigated crops. It is limited mainly by the availability of irrigation water and the moderate hazards of soil blowing and water erosion.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients or increasing the risk of water erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping in nonirrigated areas, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and lilac.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

88C—Shano very fine sandy loam, 7 to 12 percent slopes. This deep, well drained soil is on terraces. It formed in loess deposited over lacustrine sediment. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown very fine sandy loam about 2 inches thick. The subsoil is pale brown coarse silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown silt loam. In some areas depth to basalt or a hardpan ranges from 40 to 60 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Adkins, Burke, Quincy, and Sagehill soils. Also included are small areas of Shano soils that have slopes of 2 to 7 percent or 12 to 20 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Shano soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if this soil is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture, leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

This unit is suited to irrigated crops. It is limited mainly by the availability of irrigation water and the moderate hazards of soil blowing and water erosion.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping in nonirrigated areas, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Austrian pine, Rocky Mountain juniper, and Siberian peashrub.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

88D—Shano very fine sandy loam, 12 to 25 percent slopes. This deep, well drained soil is on terrace scarps. It formed in loess deposited over lacustrine sediment. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown very fine sandy loam about 2 inches thick. The subsoil is pale brown coarse silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown silt loam. In some areas depth to basalt or a hardpan ranges from 40 to 60 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Adkins, Burke, Prosser, Quincy, and Sagehill soils. Also included are small areas of Shano soils that have slopes of 2 to 12 percent or 25 to 40 percent. Included areas make up about 35 percent of the total acreage.

Permeability of this Shano soil is moderate. Available water capacity is about 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the

hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used mainly as rangeland and wildlife habitat. It is also used for nonirrigated small grain.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

Because precipitation is not sufficient for annual cropping a cropping system that includes small grain and summer fallow is most suitable.

This unit is suited to nonirrigated crops. It is limited by the high hazard of water erosion and the moderate hazard of soil blowing. The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Other practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, stripcropping where feasible, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are green ash, Scotch pine, and Peking cotoneaster.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture on this unit, leave more crop residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

89B—Shano silt loam, 2 to 7 percent slopes. This deep, well drained soil is on terraces. It formed in loess deposited over lacustrine sediment. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown coarse silt loam about 2 inches thick. The subsoil is pale brown coarse silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown coarse silt loam. In some areas depth to basalt or a hardpan ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Adkins, Burke, Prosser, Quincy, and Sagehill soils. Also included are small areas of Shano soils that have slopes of 7 to 12 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Shano soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop

residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

This unit is suited to irrigated crops. It is limited mainly by the availability of irrigation water and the moderate hazards of soil blowing and water erosion.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients or increasing the risk of water erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping in nonirrigated areas, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and lilac.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

89C—Shano silt loam, 7 to 12 percent slopes. This deep, well drained soil is on terraces. It formed in loess deposited over lacustrine sediment. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown coarse silt loam about 2 inches thick. The subsoil is pale brown coarse silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown coarse silt loam. In some areas depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Adkins, Burke, Prosser, Quincy, and Sagehill soils. Also included are small areas of Shano soils that have slopes of 2 to 7 percent or 12 to 20 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Shano soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Among the other crops grown are irrigated corn for silage and grain, alfalfa hay, Irish potatoes, and small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazards of water erosion and soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces

soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration. To reduce erosion and increase conservation of soil moisture, leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitations are the availability of irrigation water, slope, and the moderate hazard of soil blowing.

Sprinkler and drip irrigation are the most suitable methods of applying water. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of water erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

Practices that can be used to reduce soil blowing are planting windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, stripcropping in nonirrigated areas, keeping the soil rough and cloddy when it is not protected by plant cover, and cultivating, planting, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Austrian pine, Rocky Mountain juniper, and Siberian peashrub.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

89D—Shano silt loam, 12 to 25 percent slopes. This deep, well drained soil is on terrace scarps. It formed in loess deposited over lacustrine sediment. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown coarse silt loam about 2 inches thick. The subsoil is pale brown coarse silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown coarse silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Adkins, Burke, Prosser, Quincy, and Sagehill soils. Also included are small areas of Shano soils that have slopes of 2 to 12 percent or 25 to 40 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Shano soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated crops, mainly small grain. Some areas are used as rangeland.

This unit is suited to nonirrigated crops. It is limited by the high hazard of water erosion and the moderate hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces

soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. Other practices that can be used to reduce soil blowing are planting windbreaks, stripcropping, using minimum tillage, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. These include green ash, Scotch pine, and Peking cotoneaster.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture, leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

89E—Shano silt loam, 25 to 40 percent slopes. This deep, well drained soil is on terrace scarps. It formed in loess deposited over lacustrine sediment. Slopes generally are south- and west-facing. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown coarse silt loam about 2 inches thick. The subsoil is pale brown coarse silt loam about 16 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown coarse silt loam. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Burke and Prosser soils and soils that are less than 20 inches deep to basalt. Also included are small areas of Rock outcrop and Shano soils that have slopes of 12 to 25 percent or 40 to 60 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Shano soil is moderate. Available water capacity is about 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are slope, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

90A—Silvies-Winom complex, 0 to 3 percent slopes. This map unit is on basin floors (fig. 7). Elevation is 3,300 to 4,300 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 20 to 90 days.

Figure 7.—Typical area of Silvies-Winom complex, 0 to 3 percent slopes. Bridgecreek soils on old terraces in background.

This unit is 35 percent Silvies silt loam and 30 percent Winom silty clay loam. The percentage varies from one area to another.

Included in this unit are small areas of Bridgecreek and Hankins soils. Also included are areas of soils that have less than 35 percent clay and are well drained. Included areas make up about 35 percent of the total acreage.

The Silvies soil is deep and poorly drained. It formed in old alluvium derived dominantly from lacustrine sediment, volcanic ash, and loess. Typically, the upper part of the surface layer is black silt loam about 15 inches thick and the lower part is black silty clay loam 10 inches thick. The next layer is dark grayish brown silty clay loam about 10 inches thick. The underlying material to a depth of 60 inches or more is dark grayish brown clay.

Permeability of the Silvies soil is slow. Available water capacity is about 7.5 to 13.0 inches. Effective rooting depth is 60 inches for water-tolerant plants but is limited to depths between 6 to 36 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table ranges from 12 inches above the surface to a depth of 36 inches below the surface throughout the year.

The Winom soil is deep and moderately well drained. It formed in old alluvium derived dominantly from lacustrine sediment. Typically, the surface layer is black silty clay loam about 8 inches thick. The next layer is black silty clay loam 5 inches thick over black clay 15 inches thick. Below this is black silty clay loam 12 inches thick over dark yellowish brown clay to a depth of 60 inches or more.

Permeability of the Winom soil is very slow. Available water capacity is about 7.5 to 13.0 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 24 to 60 inches in spring. This soil is subject to rare periods of flooding.

This unit is used for hay and pasture and as rangeland. The main limitations are the slow and very slow permeability and wetness.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Grazing or use of equipment for seeding and tillage should be avoided during this time.

The potential plant community on this unit is mainly Nebraska sedge, Baltic rush, and willow.

91A—Stanfield silt loam, 0 to 3 percent slopes. This moderately well drained soil is on terraces. It is moderately deep to a hardpan. It formed in silty alluvium. Elevation is 500 to 1,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 195 days.

Typically, the surface layer is light brownish gray coarse silt loam about 6 inches thick. The subsurface layer is light brownish gray coarse silt loam about 7 inches thick. The upper 9 inches of the substratum is pale brown coarse silt loam, the next 19 inches is a cemented hardpan, and the lower part to a depth of 58 inches or more is light brownish gray coarse silt loam. Depth to the cemented hardpan ranges from 20 to 40 inches. In many areas, there is a series of two or more pans. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Esquatzel, Pedigo, Powder, and Umapine soils and Vitrandepts. Also included are small areas of soils that are similar to this Stanfield soil but that have a hardpan at a depth of 10 to 20 inches or are not strongly alkaline. Included areas make up about 30 percent of the total acreage.

Permeability of this Stanfield soil is moderate to a depth of 22 inches and very slow below this depth. Available water capacity is about 2.5 to 7.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil contains large amounts of sodium.

This unit is used mainly for pasture and rangeland; however, in areas that are being reclaimed, irrigated small grain and alfalfa and nonirrigated small grain also are grown. The unit is limited mainly by the hazard of soil blowing, the presence of a hardpan, and excess sodium.

Although the soil in this unit has a high content of toxic salts, particularly sodium, under natural conditions, it can be used successfully to grow crops if steps are taken to reduce the content of these salts. Practices that can be used to reduce the content of salts include ripping the hardpan, where feasible; applying proper amounts of soil amendments; irrigating and leaching; growing salt-tolerant crops; and returning crop residue to the soil. Subsurface drains may be necessary in some areas to remove excess water and provide an outlet for leached salts.

Irrigation water can be applied by flood or sprinkler methods. Leveling helps to ensure the uniform application and removal of water.

The concentration of salts and alkali in the soil limits the production of plants suitable for pasture; for this reason, salt-tolerant species are most suitable for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Soil blowing generally is not a problem when the soil in this unit is in permanent pasture; however, when the plant cover is removed by overgrazing or tillage, the soil is susceptible to blowing. Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. Among the trees and shrubs that are suitable for windbreaks are Lombardy poplar, Scotch pine, and lilac.

The potential plant community on this unit is mainly basin wildrye, saltgrass, and black greasewood. The production of forage is limited by low annual precipitation and excess sodium.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is the excess sodium in the soil. The plants selected for seeding should be salt-tolerant and meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

92A—Stanfield silt loam, reclaimed, 0 to 3 percent slopes. This moderately deep, moderately well drained soil is on terraces. It formed in silty alluvium. Elevation is 500 to 1,500 feet. The average annual precipitation is 9

to 12 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 150 to 195 days.

Typically, the surface layer is light brownish gray coarse silt loam about 6 inches thick. The subsurface layer is light brownish gray coarse silt loam about 15 inches thick. The upper 9 inches of the substratum is light brownish gray coarse silt loam, and the lower part to a depth of 60 inches or more is a cemented hardpan. Depth to the cemented hardpan ranges from 20 to 40 inches. In many areas, there is a series of two or more hardpans. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Ellisforde and Powder soils, Stanfield soils that have not been reclaimed, and Umapine soils. Also included are small areas of soils that are similar to this Stanfield soil but that have a hardpan at a depth of 10 to 20 inches. Included areas make up about 20 percent of the total acreage.

Permeability of this Stanfield soil is moderate to a depth of 22 inches and very slow below this depth. Available water capacity is about 2.5 to 8.5 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most areas of this unit are used for irrigated alfalfa for hay and seed and small grain. A few areas are used for pasture and rangeland. The unit is limited mainly by the hazard of soil blowing and the presence of a hardpan.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and increasing the risk of erosion or developing a perched water table, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Poor irrigation water management can cause excessive amounts of salt to accumulate near the soil surface.

If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 10 to 12 years of alfalfa for seed and 2 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for pasture, proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by flood or sprinkler methods. Leveling helps to ensure the uniform application of water.

Soil blowing generally is not a problem when the soil in this unit is in permanent pasture; however, when the plant cover is removed by overgrazing or tillage, the soil is susceptible to blowing. Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. Among the trees and shrubs that are suitable for windbreaks are Lombardy poplar, Scotch pine, and caragana.

The potential plant community on this unit is mainly saltgrass and basin wildrye.

93B—Starbuck very fine sandy loam, 2 to 20 percent slopes. This shallow, well drained soil is on strath terraces of the Columbia River. It formed in loess and eolian sand. Elevation is 450 to 1,200 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown very fine sandy loam about 10 inches thick. The subsoil is brown fine sandy loam about 8 inches thick. Basalt is at a depth of 18 inches. Depth to bedrock ranges from 12 to 20 inches.

Included in this unit are small areas of Quinton and Quincy soils and areas of Rock outcrop. Also included are small areas of soils that are similar to this Starbuck soil but have bedrock at a depth of 20 to 60 inches. Included areas make up about 25 percent of the total acreage.

Permeability of this Starbuck soil is moderate. Available water capacity is about 1.5 to 3.5 inches. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland and for wildlife habitat. A few areas are used for recreational development.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the depth to rock, low natural fertility, and low rainfall. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more

desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are depth to rock, low rainfall, and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. In general, winter is the best season for grazing on this unit. Areas of this unit that are heavily infested with undesirable plants may be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for recreational development, the main limitations are the depth to rock, the hazard of soil blowing, and the areas of Rock outcrop.

Excavation for structures and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

Soil blowing can be reduced by maintaining plant cover and by the use of windbreaks. If irrigation is used, most climatically adapted trees and shrubs can be grown. Among the trees and shrubs that are suitable are green ash, Rocky Mountain juniper, and lilac.

Plant cover can be established and maintained through proper fertilization, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

94A—Starbuck-Rock outcrop complex, 0 to 5 percent slopes. This map unit is on strath terraces of the Columbia River. Elevation is 450 to 1,200 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is 55 percent Starbuck very fine sandy loam and 25 percent Rock outcrop. The percentage varies from one area to another.

Included in this unit are small areas of soils that are similar to this Starbuck soil but have bedrock at a depth of 20 to 60 inches and areas of Adkins, Quincy, and Quinton soils. Included areas make up about 20 percent of the total acreage.

The Starbuck soil is shallow and well drained. It formed in loess and eolian sand. Typically, the surface layer is brown very fine sandy loam about 10 inches thick. The subsoil is brown fine sandy loam about 8 inches thick. Basalt is at a depth of 18 inches. Depth to basalt ranges from 12 to 20 inches. In some areas the surface layer is silt loam or fine sandy loam.

Permeability of the Starbuck soil is moderate. Available water capacity is about 1.5 to 3.5 inches. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Rock outcrop consists of areas of exposed basalt.

Most areas of this unit are used for pasture and rangeland. A few areas are used for parks and other recreational areas and for wildlife habitat.

If this unit is used for hay and pasture, the main limitations are depth to rock and the areas of Rock outcrop. Because of the areas of Rock outcrop, flooding generally is the most suitable method of applying water; however, in some places where the areas of Rock outcrop are small, sprinkler systems may be feasible.

Because the soil is shallow and the topography of this unit is undulating, much of the excess irrigation water accumulates in depressional areas and remains there all year. This condition can be controlled if irrigation water is used more efficiently and areas that have less Rock outcrop and are more nearly level are selected for irrigation. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

The potential plant community on this unit is mainly bluebunch wheatgrass, needleandthread, Sandberg bluegrass, and big sagebrush. The production of forage is limited by the shallow depth of the soil and low rainfall.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are depth to rock, the moderate hazard of soil blowing, and the areas of Rock outcrop. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. In general, winter is the best season for grazing. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for homesite or recreational development, the main limitations are depth to rock, the areas of Rock outcrop, and the moderate hazard of soil blowing.

When developing this unit for recreational purposes, the areas of Rock outcrop should be avoided unless they are features to be highlighted in the development.

Cuts needed to provide essentially level building sites can expose bedrock. Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

The limited depth to bedrock interferes with excavations for installing utilities and does not provide adequate soil depth for septic tank absorption fields.

95B—Taunton fine sandy loam, 1 to 7 percent slopes. This moderately deep, well drained soil is on strath terraces of the Columbia River. It formed in eolian sand deposited over cemented alluvium. Elevation is 400 to 1,100 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The subsoil is brown fine sandy loam about 5 inches thick. The substratum is light brownish gray fine sandy loam about 15 inches thick over a cemented hardpan. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Adkins soils; Adkins, gravelly substratum, soils; and Quincy soils. Also included are small areas of Taunton soils that have slopes of 7 to 20 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Taunton soil is moderate to a depth of 26 inches and very slow below this depth. Available water capacity is about 2.5 to 6.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most areas of this unit are used for irrigated crops such as Irish potatoes, corn for grain and silage, small grain, and alfalfa hay. Among the other crops grown is nonirrigated small grain. Some areas are used for pasture, homesite development, rangeland, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, the moderate hazard of soil blowing, and the presence of a hardpan.

Sprinkler and drip irrigation systems are suitable methods of applying water. Center pivot irrigation systems are most commonly used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and developing a perched water table, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 to 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and lilac.

If this unit is used for nonirrigated crops, the main limitations are the moderate hazard of soil blowing and low rainfall. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Other practices that can be used to control erosion and conserve moisture include seeding early in fall, performing minimum tillage, and stripcropping.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too moist or too dry may result in compaction of the surface layer, poor tilth, and excessive erosion.

Border, corrugation, and sprinkler irrigation systems are suited to this unit. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the moderate hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

Population growth has resulted in increased construction of homes on this unit. The main limitations are low rainfall, the moderate hazard of soil blowing, and the very slow permeability of the hardpan.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed.

The very slow permeability of the hardpan increases the possibility of failure of septic tank absorption fields. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. It is difficult to establish plants in areas where the upper part of the soil has been removed, exposing the hardpan. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

96B—Thatuna silt loam, 1 to 7 percent slopes. This deep, moderately well drained soil is on plateaus of the Blue Mountains. It formed in loess and residuum. Elevation is 2,400 to 3,200 feet. The average annual precipitation is 18 to 23 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is dark grayish brown silt loam about 18 inches thick. The subsurface layer is very pale brown silt loam about 12 inches thick. Below this is a buried subsoil of pale brown and light yellowish brown silty clay loam about 30 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Palouse and Waha soils. Also included are small areas of soils that are similar to this Thatuna soil but that have more than 35 percent clay in the subsoil and Thatuna soils that have slopes of 7 to 20 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Thatuna soil is moderate to a depth of 30 inches and slow below this depth. Available water capacity is about 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. Water is perched above the silty clay loam subsoil during March through May.

Most areas of this unit are used for nonirrigated small grain and pasture. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops and is cropped annually with winter or spring small grain. A few areas can be cropped using a small grain-pea rotation. This unit is limited mainly by the water table that is perched in spring and by the hazard of water erosion.

Because of the perched water table, the soil remains wet for long periods in spring. When the soil is in this condition, it is subject to displacement, compaction, and erosion. Tillage equipment should be kept off the soil until it has drained.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for hay and pasture, the main limitations are the perched water table and the hazard of water erosion.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Fertilizer is needed to ensure optimum growth of grasses and legumes.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and hawthorn. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

96D—Thatuna silt loam, 7 to 20 percent slopes. This deep, moderately well drained soil is on plateaus of the Blue Mountains. It formed in loess and residuum. Elevation is 2,400 to 3,200 feet. The average annual precipitation is 18 to 23 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is dark grayish brown silt loam about 18 inches thick. The subsurface layer is very pale brown silt loam about 12 inches thick. Below this is a buried subsoil of pale brown and light yellowish brown silty clay loam about 30 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Palouse and Waha soils. Also included are small areas of soils that are similar to this Thatuna soil but that have more than 35 percent clay in the subsoil and Thatuna soils that have slopes of 1 to 7 percent or 20 to 30 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Thatuna soil is moderate to a depth of 30 inches and slow below this depth. Available water capacity is about 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. Water is perched above the silty clay loam subsoil during March through May.

Most areas of this unit are used for nonirrigated small grain and pasture. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited mainly by a water table that is perched in spring and by the hazard of water erosion. Because of the perched water table, the soil remains wet for long periods in spring. When the soil is in this condition, it is subject to displacement, compaction, and erosion. Tillage equipment should be kept off the soil until it has drained.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. To reduce erosion and increase conservation of soil moisture, reduce the distance between terraces and leave more crop residue on the surface. In the steeper parts of this unit, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for hay and pasture, the main limitations are the perched water table and the hazard of water erosion.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Fertilizer is needed to ensure optimum growth of grasses and legumes.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and hawthorn. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred

forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

97C—Tolo silt loam, 3 to 15 percent slopes. This deep, well drained soil is on plateaus of the Blue Mountains. It formed in volcanic ash over a buried soil. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 18 to 45 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 30 to 100 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown silt loam about 4 inches thick. The subsoil is very pale brown silt loam about 18 inches thick. The next layer is a buried subsoil of light yellowish brown silt loam about 38 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to bedrock ranges from 40 to 60 inches.

Included in this unit are small areas of Albee, Anatone, Bocker, and Klicker soils. Also included are small areas of soils that are similar to this Tolo soil but have more than 40 inches or less than 20 inches of ash over the buried soil and small areas of Tolo soils that have slopes of 15 to 35 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Tolo soil is moderate to a depth of 22 inches and moderately slow below this depth. Available water capacity is about 12 to 19 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for timber production, livestock grazing, and wildlife habitat. A few areas are used for homesite development and recreation.

This unit is suited to the production of grand fir and Douglas-fir (fig. 8). Other species that grow on the unit include western larch and lodgepole pine. The understory is mainly princes pine, myrtle pachystima, and elk sedge.

On the basis of a 50-year site curve, the mean site index for grand fir is 85. Thus, the mean annual increment for 80-year-old trees is 122 cubic feet per acre. The culmination of mean annual increment (CMAI) is 123 cubic feet per acre at 100 years of age for all trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are the hazards of compaction and erosion.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily when the soil is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.

Natural reforestation of harvested areas by grand fir, Douglas-fir, western larch, and lodgepole pine occur if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management.

97E—Tolo silt loam, 15 to 35 percent slopes. This deep, well drained soil is on hillslopes of the Blue

Figure 8.—Grand fir, western larch, common snowberry, and Oregon-grape in an area of Tolo silt loam, 3 to 15 percent slopes.

Mountains. It formed in volcanic ash over a buried residual soil. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 18 to 45 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 30 to 100 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown silt loam about 4 inches thick. The subsoil is very pale brown silt loam about 18 inches thick. Below this is a buried subsoil of light yellowish brown silt loam about 38 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to bedrock ranges from 40 to 60 inches.

Included in this unit are small areas of Albee, Anatone, Bocker, Kahler, Klicker, and Umatilla soils. Also included are small areas of soils that are similar to this Tolo soil but have more than 40 inches or less than 20 inches of ash over the buried soil and small areas of Tolo soils that have slopes of 3 to 15 percent or 35 to 65 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Tolo soil is moderate to a depth of 22 inches and moderately slow below this depth. Available water capacity is about 12 to 19 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for timber production, livestock grazing, and wildlife habitat. A few areas are used for homesite development and recreation.

This unit is suited to the production of grand fir and Douglas-fir. Other species that grow on the unit include western larch and lodgepole pine. The understory is mainly princes pine, myrtle pachystima, and elk sedge.

On the basis of a 50-year site curve, the mean site index for grand fir is 85. Thus, the mean annual increment for 80-year-old trees is 122 cubic feet per acre. The culmination of mean annual increment (CMAI) is 123 cubic feet per acre at 100 years of age for all trees 1 inch and larger in diameter.

The main limitations for the management of timber are the hazards of compaction and erosion and steepness of slope.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily when the soil is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

In the more steeply sloping areas, road location is more difficult and maintenance costs are greater. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.

Natural reforestation of harvested areas by grand fir, Douglas-fir, western larch, and lodgepole pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

98C—Tolo silt loam, granite substratum, 3 to 15 percent slopes. This deep, well drained soil is on plateaus of the Blue Mountains. It formed in volcanic ash over a buried soil. Elevation is 3,900 to 4,800 feet. The average annual precipitation is 20 to 26 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface is covered with a mat of needles and twigs about 3 inches thick. The surface layer is brown silt loam about 12 inches thick. The subsoil is light yellowish brown and yellowish brown silt loam about 19 inches thick. The next layer is a buried subsoil of light yellowish brown gravelly sandy loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark brown gravelly sandy clay loam.

Included in this unit are small areas of Kilmerque soils. Also included are small areas of soils that are similar to this Tolo soil but that have more than 40 inches or less than 20 inches of ash over the buried soil and small areas of Tolo soils that have slopes of 15 to 35 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Tolo soil is moderate to a depth of 31 inches and moderately slow below this depth. Available water capacity is about 8 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir and grand fir. Other species that grow on this unit include western larch. The understory is mainly elk sedge, princes pine, and myrtle pachystima.

On the basis of a 50-year site curve, the mean site index for grand fir is 65. Thus, the mean annual increment for 80-year-old trees is 76 cubic feet per acre. The culmination of mean annual increment (CMAI) is 82 cubic feet per acre at 110 years for trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are the hazards of compaction, erosion, and plant competition.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily when the soil is dry.

Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods. If the road base is on the buried subsoil, roads are highly susceptible to gullying unless they are provided with adequate water bars or suitable surfacing.

Natural reforestation of harvested areas by grand fir, Douglas-fir, and western larch occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

98E—Tolo silt loam, granite substratum, 15 to 35 percent slopes. This deep, well drained soil is on hillslopes of the Blue Mountains. It formed in volcanic ash over a buried soil. Elevation is 3,900 to 4,800 feet. The average annual precipitation is 20 to 26 inches, the average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface is covered with a mat of needles and twigs about 3 inches thick. The surface layer is brown silt loam about 12 inches thick. The subsoil is light yellowish brown and yellowish brown silt loam about 19 inches thick. The next layer is a buried subsoil of light yellowish brown gravelly sandy loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark brown sandy clay loam.

Included in this unit are small areas of Kahler, Kilmerque, and Umatilla soils. Also included are small areas of soils that are similar to this Tolo soil but that have more than 40 inches or less than 20 inches of ash over the buried soil and small areas of Tolo soils that have slopes of 3 to 15 percent or 35 to 70 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Tolo soil is moderate to a depth of 31 inches and moderately slow below this depth. Available water capacity is about 8 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir and grand fir. Other species that grow on this unit include western larch. The understory in mainly elk sedge, princes pine, and myrtle pachystima.

On the basis of a 50-year site curve, the mean site index for grand fir is 65. Thus, the mean annual increment for 80-year-old trees is 76 cubic feet per acre. The culmination of mean annual increment (CMAI) is 82 cubic feet per acre at 110 years for all trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are the hazards of compaction and erosion, steepness of slope, and plant competition.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily when the soil is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash

layer. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods. If the road base is on the buried subsoil it is highly susceptible to gullying unless provided with adequate water bars or suitable surfacing.

Natural reforestation of harvested areas by grand fir, Douglas-fir, and western larch occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

99C—Tolo-Kilmerque association, 3 to 15 percent slopes. This map unit is on plateaus of the Blue Mountains. Elevation is 3,900 to 4,800 feet. The average annual precipitation is 20 to 26 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 50 percent Tolo silt loam and 40 percent Kilmerque loam.

Included in this unit are small areas of soils that are similar to the Tolo soil but that have more than 40 inches or less than 20 inches of ash over the buried soil and small areas of soils that are similar to the Kilmerque soil but that have more than 35 percent rock fragments within the profile. Also included are small areas of Tolo and Kilmerque soils that have slopes of 15 to 35 percent. Included areas make up about 10 percent of the total acreage.

The Tolo soil is deep and well drained. It formed in volcanic ash over a buried soil and generally is on north- and east-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 3 inches thick. The surface layer is brown silt loam about 12 inches thick. The subsoil is light yellowish brown and yellowish brown silt loam about 19 inches thick. The next layer is a buried subsoil of light yellowish brown gravelly sandy loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark brown gravelly sandy clay loam.

Permeability of the Tolo soil is moderate to a depth of 31 inches and moderately slow below this depth. Available water capacity is about 8 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Kilmerque soil is moderately deep and well drained. It formed in residuum mixed with loess and generally is on south- and west-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is grayish brown and brown loam about 12 inches thick. The subsoil is light olive brown cobbly sandy loam about 20 inches thick. The substratum to a depth of 40 inches or more is partially decomposed granodiorite. Depth to decomposed bedrock ranges from 20 to 40 inches.

Permeability of the Kilmerque soil is moderate. Available water capacity is about 2 to 6 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production, livestock grazing, and wildlife habitat.

The Tolo soil is suited to the production of Douglas-fir and grand fir. Other species that grow on this soil include western larch. The understory is mainly elk sedge, princes pine, and myrtle pachystima.

On the basis of a 50-year site curve, the mean site index for grand fir is 65. Thus, the mean annual increment for 80-year-old trees is 76 cubic feet per acre. The culmination of mean annual increment (CMAI) is 82 cubic feet per acre at 110 years for all trees 1 inch and larger in diameter at breast height.

The Kilmerque soil is suited to the production of ponderosa pine. Other species that grow on this soil include Douglas-fir. The understory in mainly elk sedge, pinegrass, and common snowberry.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 85. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 64 cubic feet per acre. The mean annual increment at culmination (CMAI) for 40-year-old trees 0.6 inch in diameter and larger at breast height is 77 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction and erosion and plant competition.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily on the Tolo soil when it is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer in the Tolo soil. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.

If the road base is on the Kilmerque soil or on the buried subsoil of the Tolo soil, it is highly susceptible to gullying unless provided with adequate water bars or suitable surfacing.

Natural reforestation of harvested areas of the Tolo soil by Douglas-fir, grand fir, and western larch occurs if a seed source is present. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings.

Natural reforestation of harvested areas of the Kilmerque soil by ponderosa pine and Douglas-fir occurs if a seed source is present. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings.

Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Seedlings planted in the less fertile subsoil grow poorly. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

99E—Tolo-Kilmerque association, 15 to 35 percent slopes. This map unit is on hillslopes of the Blue Mountains. Elevation is 3,900 to 4,800 feet. The average annual precipitation is 20 to 26 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 45 percent Tolo silt loam and 35 percent Kilmerque loam.

Included in this unit are small areas of Kahler and Umatilla soils and soils that are similar to the Tolo soil but that have more than 40 inches of ash over the buried soil. Also included are small areas of Tolo and Kilmerque soils that have slopes of 3 to 15 percent or 35 to 70 percent. Included areas make up about 20 percent of the total acreage.

The Tolo soil is deep and well drained. It formed in volcanic ash over a buried soil and is on north- and east-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 3 inches thick. The surface layer is brown silt loam about 12 inches thick. The subsoil is light yellowish brown and yellowish brown silt loam about 19 inches thick. The next layer is a buried subsoil of light yellowish brown gravelly sandy loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark brown gravelly sandy clay loam.

Permeability of the Tolo soil is moderate to a depth of 31 inches and moderately slow below this depth. Available water capacity is about 8 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Kilmerque soil is moderately deep and well drained. It formed in residuum mixed with loess and is on south- and west-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is grayish brown and brown loam about 12 inches thick. The subsoil is light olive brown cobbly sandy loam about 20 inches thick. The substratum to a depth of 40 inches or more is partially decomposed granodiorite. Depth to decomposed bedrock ranges from 20 to 40 inches.

Permeability of the Kilmerque soil is moderate. Available water capacity is about 2 to 6 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

The Tolo soil is suited to the production of Douglas-fir and grand fir. Other species that grow on this soil include western larch. The understory is mainly elk sedge, princes pine, and myrtle pachystima.

On the basis of a 50-year site curve, the mean site index for grand fir is 65. Thus, the mean annual increment for 80-year-old trees is 76 cubic feet per acre. The culmination of mean annual increment (CMAI) is 82 cubic feet per acre at 110 years for all trees 1 inch and larger in diameter at breast height.

The Kilmerque soil is suited to the production of ponderosa pine. Other species that grow on this soil include Douglas-fir. The understory in mainly elk sedge, pinegrass, and Oregon-grape.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 85. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 64 cubic feet per acre. The mean annual increment at culmination (CMAI) for 40-year-old trees 0.6 inch and larger in diameter at breast height is 77 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction and erosion, steepness of slope, and plant competition.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily on the Tolo soil when it is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer in the Tolo soil. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft. They may be impassable during rainy periods.

If the road base is on the Kilmerque soil or on the buried subsoil of the Tolo soil, it is highly susceptible to gullying unless provided with adequate water bars or suitable surfacing.

Natural reforestation of harvested areas of the Tolo soil by Douglas-fir, grand fir, and western larch occurs if a seed source is present. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings.

Natural reforestation of harvested areas of the Kilmerque soil by ponderosa pine and Douglas-fir occurs if a seed source is present. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings.

Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Seedlings planted in the less fertile subsoil grow poorly. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

100C—Tolo-Klicker association, 3 to 15 percent slopes. This map unit is on plateaus of the Blue Mountains. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 40 percent Tolo silt loam and 30 percent Klicker silt loam.

Included in this unit are small areas of Albee, Anatone, and Bocker soils. Also included are small areas of soils that are similar to the Klicker soil but that have an ash layer 5 to 20 inches thick on the surface and small areas of Tolo and Klicker soils that have slopes of 15 to 35 percent. Included areas make up about 30 percent of the total acreage.

The Tolo soil is deep and well drained. It formed in volcanic ash over a buried soil and generally is on north- and east-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown silt loam about 4 inches thick. The subsoil is very pale brown silt loam about 18 inches thick. Below this is a buried subsoil of light yellowish brown silt loam about 38 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches.

Permeability of the Tolo soil is moderate to a depth of 22 inches and moderately slow below this depth. Available water capacity is about 12 to 19 inches.

Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

The Klicker soil is moderately deep and well drained. It formed in residuum mixed with loess and generally is on south- and west-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark reddish brown silt loam about 7 inches thick. The subsoil is dark reddish brown very cobbly silty clay loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Klicker soil is moderately slow. Available water capacity is about 2.5 to 7.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production, livestock grazing, and wildlife habitat.

The Tolo soil is suited to the production of grand fir, Douglas-fir, and western larch. Other species that grow on this soil include lodgepole pine. The understory in mainly elk sedge, princes pine, and myrtle pachystima.

On the basis of a 50-year site curve, the mean site index for grand fir is 85. Thus, the mean annual increment for 80-year-old trees is 122 cubic feet per acre. The culmination of mean annual increment (CMAI) is 124 cubic feet per acre at 100 years for all trees 1 inch and larger in diameter at breast height.

The Klicker soil is suited to the production of ponderosa pine. Other species that grow on this soil include Douglas-fir. The understory is mainly common snowberry, elk sedge, and pinegrass.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 76. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 51 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 63 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction and erosion, steepness of slope, the high content of rock fragments in the Klicker soil, and plant competition.

Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily on the Tolo soil when it is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer in the Tolo soil. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft and slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas of the Tolo soil by Douglas-fir, grand fir, and western larch occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly.

Natural reforestation of harvested areas of the Klicker soil by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted.

Undesirable plants on the Tolo soil limit adequate natural or artificial reforestation unless site preparation and maintenance are intensive. Intensive site preparation and maintenance generally are not needed on the Klicker soil.

Because roots are restricted by bedrock, trees on the Klicker soil are subject to windthrow.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

100E—Tolo-Klicker association, 15 to 35 percent slopes. This map unit is on hillslopes of the Blue Mountains. Elevation is 3,000 to 4,500 feet. The average annual precipitation is 20 to 40 inches, the average

annual air temperature is 42 to 45 degrees F, and the average frost-free period is 60 to 100 days.

This unit is 40 percent Tolo silt loam and 30 percent Klicker silt loam.

Included in this unit are small areas of Albee, Anatone, Bocker, Kahler, and Umatilla soils. Also included are small areas of soils that are similar to the Klicker soil but that have a 5- to 20-inch-thick layer of ash and small areas of Tolo and Klicker soils that have slopes of 3 to 15 percent or 35 to 50 percent. Included areas make up about 30 percent of the total acreage.

The Tolo soil is deep and well drained. It formed in volcanic ash over a buried soil and is on north- and east-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown silt loam about 4 inches thick. The subsoil is very pale brown silt loam about 18 inches thick. Below this is a buried subsoil of light yellowish brown silt loam about 38 inches thick over basalt. Depth to basalt is 60 inches or more. In some areas depth to basalt ranges from 40 to 60 inches.

Permeability of the Tolo soil is moderate to a depth of 22 inches and moderately slow below this depth. Available water capacity is about 12 to 19 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Klicker soil is moderately deep and well drained. It formed in residuum mixed with loess and is on south- and west-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown silt loam about 7 inches thick. The subsoil is dark brown very cobbly silty clay loam about 14 inches thick. Basalt is at a depth of 21 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Klicker soil is moderately slow. Available water capacity is about 2.5 to 7.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

The Tolo soil is suited to the production of grand fir, Douglas-fir, and western larch. Other species that grow on this soil include lodgepole pine. The understory is mainly elk sedge, princes pine, and myrtle pachystima.

On the basis of a 50-year site curve, the mean site index for grand fir is 85. Thus, the mean annual increment for 80-year-old trees is 122 cubic feet per acre. The culmination of mean annual increment (CMAI) is 124 cubic feet per acre at 100 years for all trees 1 inch and larger in diameter at breast height.

The Klicker soil is suited to the production of ponderosa pine. Other species that grow on this soil include Douglas-fir. The understory is mainly common snowberry, elk sedge, and pinegrass.

On the basis of a 100-year site curve, the mean site index for ponderosa pine is 76. Thus, the mean annual increment for 80-year-old trees 6.6 inches and larger in diameter at breast height is 51 cubic feet per acre. The mean annual increment at culmination (CMAI) for 50-year-old trees 0.6 inch and larger in diameter at breast height is 63 cubic feet per acre.

The main limitations for the management of timber are the hazards of compaction and erosion, steepness of slope, the high content of rock fragments in the Klicker soil, and plant competition on the Tolo soil.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Displacement of the surface layer occurs most readily on the Tolo soil when it is dry. Using low-pressure ground equipment damages the soil less and helps to maintain productivity.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. Construction and maintenance of roads built on this unit are difficult because of the 20- to 40-inch-thick ash layer in the Tolo soil. This material makes poor subgrade for roads because it does not compact easily when dry, has high potential for frost action, and has high available water capacity. When wet or moist, unsurfaced roads and skid trails are soft and slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas of the Tolo soil by Douglas-fir, grand fir, and western larch occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Mortality of naturally established seedlings may be high if logging or scarification displaces the layer of ash. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. Seedlings planted in the less fertile subsoil grow poorly.

Natural reforestation of harvested areas of the Klicker soil by ponderosa pine occurs if a seed source is present. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted.

Undesirable plants on the Tolo soil limit adequate natural or artificial reforestation unless site preparation and maintenance are intensive. Intensive site preparation

and maintenance generally are not needed on the Klicker soil.

Because roots are restricted by bedrock, trees on the Klicker soil are subject to windthrow.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

101A—Tolo Variant silt loam, 0 to 3 percent slopes. This deep, poorly drained soil is on basin floors. It formed in volcanic ash and alluvium. Elevation is 3,900 to 5,000 feet. The average annual precipitation is 30 to 60 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is less than 30 days to 60 days.

Typically, the surface layer is dark gray silt loam about 14 inches thick. The upper 12 inches of the subsoil is white silt loam, and the lower 34 inches is light gray silt loam.

Included in this unit are small areas of Helter and Tolo soils. Also included are small areas of soils that are similar to this Tolo Variant soil but are moderately well drained. Included areas make up about 15 percent of the total acreage.

Permeability of this Tolo Variant soil is moderate. Available water capacity is about 14 to 17 inches. Effective rooting depth is 60 inches for water-tolerant plants but is limited to depths between 6 and 36 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. Depth to a seasonal high water table ranges from 12 inches above the surface to 36 inches below the surface in March through October. This soil is subject to long periods of flooding in March through June.

Most areas of this unit are used as wildlife habitat. A few areas are used for recreation and livestock grazing.

If this unit is used for recreational development, the main limitation is the seasonal high water table. This severely limits the use of the unit as camp and picnic areas and for use by off-road vehicles.

If this unit is used for livestock grazing, the main limitation is the seasonal high water table.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. The water table is nearest the surface in spring. Grazing or use of equipment for seeding or tillage should be avoided during this time.

102C—Tutuilla silty clay loam, 1 to 15 percent slopes. This deep, well drained soil is on summits of foothills of the Blue Mountains. It formed in loess over metasedimentary material. Elevation is 3,600 to 4,000 feet. The average annual precipitation is 24 to 28 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 100 to 125 days.

Typically, the surface layer is dark grayish brown silty clay loam about 19 inches thick. The subsoil is brown clay about 31 inches thick. The substratum to a depth of 60 inches or more is partially weathered metasedimentary material.

Included in this unit are small areas of Bridgecreek, Gurdane, Gwinly, Hankins, and Silvies soils. Also included are small areas of soils that are similar to this Tutuilla soil but have less than 35 percent clay in the subsoil, Tutuilla soils that have slopes of 15 to 35 percent, ash pockets, and rock outcroppings. Included areas make up about 25 percent of the total acreage.

Permeability of this Tutuilla soil is very slow. Available water capacity is about 6 to 12 inches. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for hay and pasture and as rangeland. It is also used for nonirrigated small grain.

If this unit is used for hay and pasture, the main limitations are the moderate hazard of water erosion and the very slow permeability.

Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is the very slow permeability. Because of the high clay content

and the very slow permeability of the soil, seeding with heavy equipment should be restricted to drier periods to reduce erosion, compaction, and rutting. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

If this unit is used for nonirrigated small grain, the main limitations are the hazard of water erosion and the very slow permeability. Although most of this unit is farmed using a grain-fallow cropping system, precipitation may be adequate to permit annual cropping.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Tillage with heavy equipment should be restricted to drier periods to reduce compaction and rutting.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, sulfur, and phosphorous fertilizer.

103E—Tutuilla silty clay loam, 15 to 35 percent north slopes. This deep, well drained soil is on foothills of the Blue Mountains. It formed in loess over metasedimentary material. Elevation is 3,600 to 4,000 feet. The average annual precipitation is 24 to 28 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 100 to 125 days.

Typically, the surface layer is dark grayish brown silty clay loam about 19 inches thick. The subsoil is brown clay about 31 inches thick. The substratum to a depth of 60 inches or more is partially weathered metasedimentary material. Depth to weathered metasedimentary material ranges from 40 to 60 inches. In some areas depth to metasedimentary material is more than 60 inches.

Included in this unit are small areas of Bridgecreek, Gurdane, and Hankins soils and areas of Rock outcrop. Also included are small areas of Tutuilla soils that have slopes of 5 to 15 percent or 35 to 50 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Tutuilla soil is very slow. Available water capacity is about 6 to 12 inches. Effective rooting depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue, hawthorn, chokecherry, and snowberry. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are steepness of slope and the very slow permeability. Because of the steepness of slope, high clay content, and very slow permeability of the soil in this unit, seeding with heavy equipment should be restricted to drier periods and the less sloping areas to reduce erosion, compaction, and rutting. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

104E—Tutuilla silty clay loam, 15 to 35 percent south slopes. This deep, well drained soil is on foothills of the Blue Mountains. It formed in loess over metasedimentary material. Elevation is 3,600 to 4,000 feet. The average annual precipitation is 24 to 28 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 100 to 125 days.

Typically, the surface layer is dark grayish brown silty clay loam about 19 inches thick. The subsoil is brown clay about 31 inches thick. The substratum to a depth of 60 inches or more is partially weathered metasedimentary material. In some areas the surface layer is stony or cobbly.

Included in this unit are small areas of Bridgecreek, Gurdane, Gwinly, and Hankins soils. Also included are small areas of soils that are similar to this Tutuilla soil but have less than 35 percent clay in the subsoil, Tutuilla soils that have slopes of 5 to 15 percent or 35 to 50 percent, ash pockets, and rock outcroppings. Included areas make up about 25 percent of the total acreage.

Permeability of this Tutuilla soil is very slow. Available water capacity is about 6 to 12 inches. Effective rooting

depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are steepness of slope and the very slow permeability. Because of the steepness of slope, the high clay content, and the very slow permeability of the soil in this unit, seeding with heavy equipment should be restricted to drier periods and the more gently sloping areas to reduce erosion, compaction, and rutting. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

105A—Umapine silt loam, 0 to 3 percent slopes. This deep, somewhat poorly drained soil is on terraces. It formed in silty alluvium. Elevation is 500 to 1,000 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 160 to 195 days.

Typically, the surface layer is pale brown silt loam about 7 inches thick. The subsoil is light brownish gray silt loam about 18 inches thick. The upper 7 inches of the substratum is light gray silt loam, the next 16 inches is white silt loam, and the lower part to a depth of 60 inches or more is brown silt loam. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Esquatzel, Pedigo, Powder, and Stanfield soils. Also included are small areas of soils that are similar to this Umapine soil but are moderately alkaline in the surface layer. Included areas make up about 20 percent of the total acreage.

Permeability of this Umapine soil is moderate. Available water capacity is about 8 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 12 to 42 inches in spring. This soil is subject to occasional periods of flooding in winter and spring. The hazard of soil blowing is moderate. This soil contains large amounts of sodium.

Most areas of this unit are used for pasture. A few areas are used for irrigated crops such as alfalfa hay and as rangeland.

This unit is limited mainly by wetness, excess sodium, and the moderate hazard of soil blowing.

Although some areas of the soil in this unit have a high content of toxic salts, particularly sodium, the soil can be used for crops if steps are taken to reduce the content of these salts. Practices that can be used to reduce the content of salts include ripping the hardpan, where feasible; applying proper amounts of soil amendments; irrigating and leaching; growing salt-tolerant crops; and returning crop residue to the soil. Subsurface drains may be necessary in some areas to remove excess water and provide an outlet for leached salts.

Irrigation water can be applied by flood or sprinkler methods. Leveling helps to ensure the uniform application and removal of water.

The concentration of salts and alkali in the surface layer limits the production of plants suitable for pasture. Wetness also limits the choice of plants, and it limits the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Soil blowing generally is not a problem when the soil in this unit is in permanent pasture; however, when the plant cover is removed by overgrazing or tillage, the soil is susceptible to soil blowing. Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. Among the trees and shrubs that are suitable for windbreaks are Lombardy poplar, Scotch pine, and caragana.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 10 or 12 years of alfalfa for seed and 2 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly basin wildrye, inland saltgrass, and black greasewood.

106A—Umapine silt loam, reclaimed, 0 to 3 percent slopes. This deep, moderately well drained soil is on terraces. It formed in silty alluvium. Elevation is 400 to

1,300 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 150 to 195 days.

Typically, the surface layer is light brownish gray coarse silt loam about 13 inches thick. The subsoil is light gray very fine sandy loam about 9 inches thick. The upper 27 inches of the substratum is white very fine sandy loam, and the lower part to a depth of 60 inches or more is light brownish gray silt loam (fig. 9). In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Stanfield soils, some of which have been reclaimed, and Umapine soils that have not been reclaimed. Also included are small areas of soils that have a hardpan at a depth of 40 to 60 inches. Included areas make up about 20 percent of the total acreage.

Permeability of this Umapine soil is moderate. Available water capacity is about 7 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. A seasonal high water table fluctuates between depths of 48 and 72 inches in winter and spring. This soil is subject to rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly small grain and alfalfa hay, and as rangeland. Among the other crops grown are corn for silage, beans, and tree fruit. Some areas are used for pasture.

This unit is suited to irrigated crops. Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Poor irrigation management can cause an excessive amount of salts to accumulate near the soil surface.

If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or corn. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for hay and pasture, proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Figure 9.—Typical profile of Umapine silt loam, reclaimed, 0 to 3 percent slopes. Note salts crusting in lower part.

Irrigation water can be applied by the sprinkler and flood methods. Leveling helps to ensure the uniform application of water.

Soil blowing generally is not a problem when the soil in this unit is in permanent pasture; however, when the plant cover is removed by overgrazing or tillage, the soil is susceptible to blowing. Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. Among the trees and shrubs that are suitable for windbreaks are Lombardy poplar, Scotch pine, and caragana.

107E—Umatilla-Kahler association, 15 to 35 percent slopes. This map unit is on hillslopes in the Blue Mountains. Slopes are convex and generally are north- or east-facing. Elevation is 2,000 to 5,000 feet. The average annual precipitation is 15 to 45 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 30 to 90 days.

This unit is 55 percent Umatilla loam and 25 percent Kahler silt loam.

Included in this unit are small areas of Buckcreek, Gwin, Klicker, and Tolo soils and Rock outcrop. Also included are small areas of soils that are similar to the Umatilla and Kahler soils but that are 20 to 60 inches deep to basalt and small areas of Umatilla and Kahler soils that have slopes of 35 to 70 percent. Included areas make up about 20 percent of the total acreage.

The Umatilla soil is deep and well drained. It formed in loess and colluvium and generally is in convex areas. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark grayish brown and brown loam about 12 inches thick. The upper 16 inches of the subsoil is brown cobbly clay loam, and the lower 32 inches or more is brown very cobbly clay loam over basalt. Depth to basalt is 60 inches or more.

Permeability of the Umatilla soil is moderate. Available water capacity is about 7 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Kahler soil is deep and well drained. It formed in loess and colluvium and generally is in concave areas. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown and brown silt loam about 20 inches thick. The upper 17 inches of the subsoil is dark brown silty clay loam, and the lower 23 inches or more is brown cobbly silty clay loam over basalt. Depth to basalt is 60 inches or more.

Permeability of the Kahler soil is moderate. Available water capacity is about 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir and grand fir. Other species that grow on this unit include western larch and ponderosa pine. The understory is mainly pinegrass, mallow ninebark, and common snowberry.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 70 on the Umatilla soil. Thus, the mean annual increment for 80-year-old trees is 59 cubic feet per acre. The culmination of mean annual increment (CMAI) is 61 cubic feet per acre at 103 years for all trees 1 inch and larger in diameter at breast height.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 75 on the Kahler soil. Thus, the mean annual increment for 80-year-old trees is 70 cubic feet per acre. The mean annual increment at culmination (CMAI) for 96-year-old trees is 71 cubic feet per acre.

The main limitations for the management of timber are the hazards of soil compaction and erosion, steepness of slope, and plant competition.

Wheeled and tracked equipment can be used, but cable yarding generally is safer in the more steeply sloping areas and disturbs the soil less. Using standard wheeled and tracked equipment when the soil is moist causes rutting and compaction. Puddling can occur when the soil is wet. Using low-pressure ground equipment reduces damage to the soil and helps to maintain productivity.

In the more steeply sloping areas, road location is more difficult and maintenance costs are greater. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Seeding road cuts and fills to a permanent plant cover reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are soft and slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by Douglas-fir and grand fir occurs readily if a seed source is present. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants limit natural or artificial reforestation where site preparation and maintenance are not adequate.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

107F—Umatilla-Kahler association, 35 to 70 percent slopes. This map unit is on hillslopes of the Blue Mountains. The native vegetation is mainly conifers and an understory of grasses, shrubs, and forbs. Slopes are convex and generally are north- or east-facing. Elevation is 2,000 to 5,000 feet. The average annual precipitation is 15 to 45 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 30 to 90 days.

This unit is 50 percent Umatilla loam and 25 percent Kahler silt loam.

Included in this unit are small areas of Buckcreek, Gwin, Klicker, and Tolo soils and Rock outcrop. Also included are small areas of soils that are similar to the Umatilla and Kahler soils but that are 20 to 60 inches deep to basalt and small areas of Umatilla and Kahler soils that have slopes of 15 to 35 percent. Included areas make up about 25 percent of the total acreage.

The Umatilla soil is deep and well drained. It formed in loess and colluvium and generally is in convex areas. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark grayish brown and brown loam about 12 inches thick. The upper 16 inches of the subsoil is brown cobbly clay loam, and the lower 32 inches or more is brown very cobbly clay loam over basalt. Depth to basalt is 60 inches or more.

Permeability of the Umatilla soil is moderate. Available water capacity is about 7 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Kahler soil is deep and well drained. It formed in loess and colluvium and generally is in concave positions. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark brown and brown silt loam about 20 inches thick. The upper 17 inches of the subsoil is dark brown silty clay loam, and the lower 23 inches or more is brown cobbly silty clay loam over basalt. Depth to basalt is 60 inches or more.

Permeability of the Kahler soil is moderate. Available water capacity is about 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir and grand fir. Other species that grow on this unit include western larch and ponderosa pine. The understory is mainly pinegrass, mallow ninebark, and common snowberry.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 70 on the Umatilla soil. Thus, the mean annual increment for 80-year-old trees is 59 cubic feet per acre. The culmination of mean annual increment (CMAI) is 61 cubic feet per acre at 103 years for all trees 1 inch and larger in diameter at breast height.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 75 on the Kahler soil. Thus, the mean annual increment for 80-year-old trees is 70 cubic feet per acre. The culmination of mean annual increment (CMAI) is 71 cubic feet per acre at 96 years for all trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are the steepness of slope, hazard of erosion, soil compaction, and plant competition.

Steepness of slope restricts the use of wheeled and tracked equipment on skid trails. Cable yarding generally is safer and disturbs the soil less.

Locating roads on midslopes results in large cuts and fills and thus removes land from production. Material cast to the side when building roads can damage vegetation. It is also a potential source of sedimentation. Because of the steepness of slope, this unit may be subject to slumping, especially where road cuts are made. End hauling of waste material minimizes damage to vegetation downslope and reduces the potential for sedimentation. Seeding road cuts and fills to permanent plant cover reduces erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are soft and slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by Douglas-fir and grand fir occurs if a seed source is present. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be

planted. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants prevent adequate natural or artificial reforestation unless intensive site preparation and maintenance are used.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

Because the overstory on this unit generally is very dense and forage production is low, livestock and wildlife usually graze areas that have been opened by logging or fire. Some of the nonforested included soils, such as the Buckcreek and Gwin soils, provide a considerable amount of forage for livestock and wildlife. Wildlife use this unit primarily as shelter from winter storms.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

108F—Umatilla-Kahler-Gwin association, 35 to 70 percent slopes. This map unit is on hillslopes of the Blue Mountains. Elevation is 2,000 to 5,000 feet. The average annual precipitation is 15 to 45 inches, the average annual air temperature is 40 to 47 degrees F, and the average frost-free period is 30 to 120 days.

This unit is 40 percent Umatilla loam, 20 percent Kahler silt loam, and 15 percent Gwin very cobbly silt loam.

Included in this unit are small areas of Buckcreek, Klicker, and Tolo soils and Rock outcrop. Also included are small areas of soils that are similar to the Umatilla and Kahler soils but that are 40 to 60 inches deep to basalt and small areas of Umatilla and Kahler soils that have slopes of 15 to 35 percent. Included areas make up about 25 percent of the total acreage.

The Umatilla soil is deep and well drained. It formed in loess and colluvium and is on north- and east-facing slopes. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark grayish brown and brown loam about 12 inches thick. The upper 16 inches of the subsoil is brown cobbly clay loam, and the lower 32 inches or more is brown very cobbly clay loam over basalt. Depth to basalt is 60 inches or more.

Permeability of the Umatilla soil is moderate. Available water capacity is about 7 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Kahler soil is deep and well drained. It formed in loess and colluvium and is on north- and east-facing slopes. Typically, the surface is covered with a mat of needles and twigs 1 inch thick. The surface layer is dark brown and brown silt loam about 20 inches thick. The upper 17 inches of the subsoil is dark brown silty clay loam, and the lower 23 inches or more is brown cobbly silty clay loam over basalt. Depth to basalt is 60 inches or more.

Permeability of the Kahler soil is moderate. Available water capacity is about 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

The Gwin soil is shallow and well drained. It formed in colluvium, residuum, and loess and is on south- and west-facing slopes. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is dark grayish brown extremely stony silt loam about 7 inches thick. The subsoil is brown very cobbly silty clay loam about 6 inches thick. Basalt is at a depth of 13 inches. Depth to basalt ranges from 10 to 20 inches.

Permeability of the Gwin soil is moderately slow. Available water capacity is about 1.5 to 2.5 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production, livestock grazing, and wildlife habitat.

The Umatilla and Kahler soils are suited to the production of Douglas-fir and grand fir. Other species that grow on these soils include western larch and ponderosa pine. The understory is mainly pinegrass, mallow ninebark, and common snowberry.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 70 on the Umatilla soil. Thus, the mean annual increment for 80-year-old trees is 59 cubic feet per acre. The culmination of mean annual increment (CMAI) is 61 cubic feet per acre at 103 years for all trees 1 inch and larger in diameter at breast height.

On the basis of a 50-year site curve, the mean site index for Douglas-fir is 75 on the Kahler soil. Thus, the mean annual increment for 80-year-old trees is 70 cubic feet per acre. The culmination of mean annual increment (CMAI) is 71 cubic feet per acre at 96 years for all trees 1 inch and larger in diameter at breast height.

The main limitations for the management of timber are steepness of slope, the hazard of erosion, and the hazard of soil compaction.

Steepness of slope restricts the use of wheeled and tracked equipment on skid trails. Cable yarding generally is safer and disturbs the soil less.

Locating roads on midslopes results in large cuts and fills and thus removes land from production. Material cast to the side when building roads can damage

vegetation. It is also a potential source of sedimentation. Because of the steepness of slope, the unit may be subject to slumping, especially where road cuts are made. End hauling of waste material minimizes damage to vegetation downslope and reduces the potential of sedimentation. Seeding road cuts and fills to a permanent plant cover reduces erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless they are provided with adequate water bars or are protected by plant cover, or both.

Logging roads require suitable surfacing for year-round use. When wet or moist, unsurfaced roads and skid trails are soft and slippery. They may be impassable during rainy periods.

Natural reforestation of harvested areas by Douglas-fir and grand fir occurs if a seed source is present. Reforestation can be accomplished by planting Douglas-fir and grand fir seedlings. The high content of rock fragments in the soil reduces seedling survival. To compensate for the higher mortality that can be expected, larger trees or more trees than normal can be planted. Ripping skid trails and landings when the soil is dry breaks up compacted layers and improves soil tilth, which increases seedling survival. Undesirable plants prevent adequate natural or artificial reforestation unless intensive site preparation and maintenance are used.

Thinning, logging, or fire reduces the density of the overstory canopy and increases the production of understory. Broadcast seeding of adapted bunchgrasses is desirable after the canopy has been opened. To reduce the mortality of planted tree seedlings as a result of plant competition, grasses and trees should be seeded at the same time.

Because the overstory canopy of the Umatilla and Kahler soils generally is very dense and forage production therefore is low, livestock and wildlife usually graze on the nonforested Gwin soil and in areas that have been opened by logging or fire. Also, included soils such as the Buckcreek soils offer a considerable amount of forage to livestock and wildlife. Wildlife use this unit primarily as shelter from winter storms.

If the understory is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

109A—Veazie silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in mixed alluvium. Elevation is 1,200 to 3,000 feet. The average annual precipitation is 14 to 25 inches, the average annual air temperature is 48 to 51 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsurface layer is brown loam and very gravelly silt loam about 13 inches thick. The substratum to a depth of 60 inches or more is brown extremely gravelly and extremely cobbly sand or loamy sand. Depth to the substratum ranges from 20 to 40 inches. Some areas have a cobbly or gravelly surface layer.

Included in this unit are small areas of Catherine Variant, Hermiston, and Onyx soils and Xerofluvents. Also included are small areas of soils that are similar to this Veazie soil but that have a gravelly substratum at a depth of more than 40 inches. Included areas make up about 20 percent of the total acreage.

Permeability of this Veazie soil is moderate to a depth of 23 inches and very rapid below this depth. Available water capacity is about 2.5 to 7.5 inches. Effective rooting depth is 60 inches for water-tolerant plants but is limited to depths between 40 and 60 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 40 and 60 inches in winter and spring. This soil is subject to brief periods of flooding in winter and spring.

This unit is used mainly for irrigated crops such as alfalfa hay, small grain, and tree fruit. It is also used for pasture, nonirrigated small grain, and homesite development.

This unit is suited to irrigated crops. It is limited mainly by the very rapid permeability and low available water capacity of the substratum and by the high water table.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. In some areas that have a water table near the surface, crops can be supplied water by subirrigation. The method used generally is governed by the crop grown. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. Handline, solid set, and overhead sprinkler systems are used; overhead sprinklers are also effective in orchards for frost control early in spring. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

In areas between fruit trees, competition for moisture from grasses and weeds can be reduced by mowing or clean cultivating.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 2 years of small grain. Shallow-rooted crops are suited to areas where drainage is not adequate. Subsurface drainage can be used to lower the water table if a suitable outlet is available.

If this unit is used for hay and pasture, the main limitations are the very rapid permeability and low available water capacity of the substratum and the high water table.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water.

If this unit is used for homesite development, the main limitations are the seasonal high water table, the hazard of flooding, and the very rapid permeability of the substratum.

Because of the seasonal high water table, drainage should be provided if buildings with basements are constructed. Wetness can be reduced by installing drain tile around footings. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this problem.

It is difficult to establish plants in areas where the surface layer has been removed, exposing the gravelly substratum. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

The very rapid permeability of the substratum and the seasonal high water table adversely affect the purification process of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

The potential plant community on this unit is mainly tufted hairgrass, bluegrass, and thin bentgrass.

110A—Veazie cobbly loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in mixed alluvium. Elevation is 1,200 to 3,000 feet. The average annual precipitation is 14 to 25 inches, the average annual air temperature is 48 to 51 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is dark grayish brown cobbly loam about 10 inches thick. The subsurface layer is brown loam and very gravelly silt loam about 13 inches thick. The substratum to a depth of 60 inches or more is brown extremely gravelly and extremely cobbly sand or loamy sand. Depth to the substratum ranges from 20 to 40 inches. Some areas have a loam, gravelly loam, and very cobbly loam surface layer.

Included in this unit are small areas of Catherine Variant soils and Xerofluvents. Included areas make up about 20 percent of the total acreage.

Permeability of this Veazie soil is moderate to a depth of 23 inches and very rapid below this depth. Available water capacity is about 2.5 to 7.5 inches. Effective rooting depth is 60 inches for water-tolerant plants but is limited to depths between 40 and 60 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 40 and 60 inches in winter and spring. This soil is subject to brief periods of flooding in winter and spring.

This unit is used mainly for irrigated crops such as alfalfa hay, small grain, and tree fruit. It is also used for pasture, rangeland, and homesite development.

This unit is suited to irrigated crops. It is limited mainly by the very rapid permeability and low available water capacity of the substratum and by the seasonal high water table.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. In areas that have a water table near the surface, crops can be supplied water by subirrigation. The method used generally is governed by the crop grown. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. Handline, solid set, and overhead sprinkler systems are used. Overhead sprinklers are also effective in orchards for frost control early in spring. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If gravity irrigation systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

In areas between fruit trees, competition for moisture from grasses and weeds can be reduced by mowing or clean cultivating. Cobbles on the surface limit the use of some equipment and increase maintenance costs.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 2 years of small grain. Shallow-rooted crops are suited to areas where drainage is not adequate. Subsurface drainage can be used to lower the water table if a suitable outlet is available.

If this unit is used for hay and pasture, the main limitations are the very rapid permeability and low available water capacity of the substratum and the high water table.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water.

If this unit is used for homesite development, the main limitations are the high water table, the hazard of flooding, and the very rapid permeability of the substratum.

Because of the seasonal high water table, drainage should be provided if buildings with basements are constructed. Wetness can be reduced by installing drain tile around footings.

Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this problem.

It is difficult to establish plants in areas where the surface and subsurface layers have been removed, exposing the substratum. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

The very rapid permeability of the substratum and the seasonal high water table adversely affect the purification process of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

The potential plant community on this unit is mainly tufted hairgrass, bluegrass, and thin bentgrass.

111A—Vitrandepts, 0 to 5 percent slopes. These deep, well drained soils are on alluvial fans and in depressional areas where volcanic ash has accumulated. They formed in alluvium derived dominantly from volcanic ash mixed with loess. Elevation is 1,000 to 1,600 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 130 to 165 days.

The surface layer ranges from loamy sand to coarse silt loam. The underlying layers range from loamy sand to gravelly silt loam. In many areas there is a buried soil beneath the ashy layers at a depth of 20 to 60 inches.

Included in this unit are small areas of Hermiston, McKay, Pilot Rock, Stanfield, Umapine, and Walla Walla soils and Xerofluvents. Included areas make up about 30 percent of the total acreage.

Permeability of these Vitrandepts is moderate. Available water capacity is variable. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. In some areas these soils are subject to brief periods of flooding during prolonged, high-intensity storms.

Most areas of this unit are used as rangeland and pastureland. A few areas are used for nonirrigated small grain and wildlife habitat. This unit can be used for irrigated crops if water is made available.

The potential plant community on this unit varies; however, plants that may occur in the community include bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

If this unit is used for hay and pasture and nonirrigated small grain, the main limitations are the moderate hazard of soil blowing, the low natural fertility, and the hazard of flooding in some areas.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Fertilizer is needed to ensure optimum growth of grasses and legumes.

Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable. Other practices that can be used to conserve soil moisture and reduce soil blowing include stubble-mulch tillage, limiting tillage for seedbed preparation and weed control, and establishing windbreaks. Most climatically adapted trees and shrubs can be grown. Among the trees that are suitable for windbreaks are green ash, black locust, and ponderosa pine. Among the shrubs are caragana and lilac.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

Clogging of culverts during floods may result in damage to roads, structures, and crops. This can be prevented by the use of larger culverts.

If this unit is used for irrigated crops, sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Because the soil in this unit is ashy, it has high available water capacity and thus requires a large amount of irrigation water to reach field capacity. Proper timing of irrigation is also important in reducing soil blowing.

112B—Waha silty clay loam, 1 to 12 percent slopes. This moderately deep, well drained soil is on ridges in the foothills of the Blue Mountains. It formed in loess and residuum. Elevation is 1,600 to 3,700 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 115 to 160 days.

Typically, the surface layer is dark grayish brown silty clay loam about 12 inches thick. The upper 16 inches of the subsoil is dark grayish brown and brown silty clay loam, and the lower 10 inches is yellowish brown gravelly silty clay loam. Basalt is at a depth of 38 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Gurdane, Gwinly, Palouse, and Rockly soils. Also included are small areas of Waha soils that have slopes of 12 to 25 percent and soils that are 40 to 60 inches deep to bedrock. Included areas make up about 15 percent of the total acreage.

Permeability of this Waha soil is moderately slow. Available water capacity is about 3 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated crops and as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops and is cropped annually using a small grain-pea rotation. It is limited by the moderate depth to bedrock and the moderate hazard of water erosion.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

112D—Waha silty clay loam, 12 to 25 percent slopes. This moderately deep, well drained soil is on hillslopes in the foothills of the Blue Mountains. It formed in loess and residuum. Slopes face south and west. Elevation is 1,600 to 3,700 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 115 to 160 days.

Typically, the surface layer is dark grayish brown silty clay loam about 12 inches thick. The upper 16 inches of the subsoil is dark grayish brown and brown silty clay

loam, and the lower 10 inches is yellowish brown gravelly silty clay loam. Basalt is at a depth of 38 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Gurdane, Gwinly, Palouse, and Rockly soils. Also included are small areas of Waha soils that have slopes of 1 to 12 percent or 25 to 40 percent and soils that are 40 to 60 inches deep to bedrock. Included areas make up about 20 percent of the total acreage.

Permeability of this Waha soil is moderately slow. Available water capacity is about 3 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for nonirrigated crops and as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops and is cropped annually using a small grain-pea rotation. It is limited by the moderate depth to bedrock and the high hazard of water erosion.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. To reduce erosion and increase conservation of soil moisture on this unit, reduce the distance between terraces and leave more crop residue on the surface. Because of slope and limited soil depth, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

112E—Waha silty clay loam, 25 to 40 percent slopes. This moderately deep, well drained soil is on foothills of the Blue Mountains. It formed in loess and residuum. Slopes face south and west. Elevation is 1,600 to 3,700 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 115 to 160 days.

Typically, the surface layer is dark grayish brown silty clay loam about 12 inches thick. The upper 16 inches of the subsoil is dark grayish brown and brown silty clay loam, and the lower 10 inches is yellowish brown gravelly silty clay loam. Basalt is at a depth of 38 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Included in this unit are small areas of Gurdane, Gwinly, Palouse, and Rockly soils. Also included are small areas of Waha soils that have slopes of 12 to 25 percent or 40 to 60 percent and soils that are 40 to 60 inches deep to bedrock. Included areas make up about 20 percent of the total acreage.

Permeability of this Waha soil is moderately slow. Available water capacity is about 3 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

Slope may limit access by livestock and result in overgrazing of the less sloping areas. Trails or walkways

can be constructed in some places to encourage livestock to graze in areas where access is limited.

113D—Waha-Rockly complex, 2 to 20 percent slopes. This map unit is on ridges in the foot slopes of the Blue Mountains. Elevation is 1,700 to 4,300 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 46 to 49 degrees F, and the average frost-free period is 115 to 120 days.

This unit is 50 percent Waha silty clay loam and 30 percent Rockly very cobbly loam. The percentage varies from one area to another. The soils occur as patterned land, locally known as biscuit-scabland. The Rockly soil is in the form of scabland between and around the areas of the Waha soil. The Waha soil is in the form of circular mounds, or biscuits, that have a convex surface and are deepest in the center.

Included in this unit are small areas of Gwin and Gwinly soils and soils that are similar to this Waha soil but have more than 35 percent rock fragments. Also included are small areas of Rockly and Waha soils that have slopes of 20 to 30 percent and soils that are 40 to 60 inches deep to bedrock. Included areas make up about 20 percent of the total acreage.

The Waha soil is moderately deep and well drained. It formed in loess and residuum. Typically, the surface layer is dark grayish brown silty clay loam about 12 inches thick. The upper 16 inches of the subsoil is dark grayish brown and brown silty clay loam, and the lower 10 inches is yellowish brown gravelly silty clay loam. Basalt is at a depth of 38 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is silt loam.

Permeability of the Waha soil is moderately slow. Available water capacity is about 3 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Rockly soil is very shallow and well drained. It formed in residuum mixed with loess. Typically, the surface layer is brown very cobbly loam about 2 inches thick. The subsoil is brown very cobbly loam about 4 inches thick. Basalt is at a depth of 6 inches. Depth to basalt ranges from 5 to 12 inches.

Permeability of the Rockly soil is moderately slow. Available water capacity is about 0.5 inch to 1.5 inches. Effective rooting depth is 5 to 12 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Waha soil is mainly Idaho fescue and bluebunch wheatgrass. The potential plant community on the Rockly soil is mainly Sandberg bluegrass, bluebunch wheatgrass, and stiff sagebrush. The production of forage is limited by the high content of rock fragments and the very shallow depth of the Rockly soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The suitability of this unit for rangeland seeding or other mechanical or chemical treatment is poor. The main limitation is the interspersed areas of the very shallow Rockly soil. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, and a planned grazing system.

114B—Walla Walla silt loam, 1 to 7 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,000 to 2,300 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is brown and pale brown silt loam about 38 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam.

Included in this unit are small areas of Anderly and Hermiston soils, Walla Walla soils that have a hardpan at a depth of 40 to 60 inches or are eroded, and Vitrandepts. Also included are small areas of Walla Walla soils that have slopes of 7 to 12 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Walla Walla soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for nonirrigated peas, for irrigated small grain and alfalfa hay, and as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion. A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable to include in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed

waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

This unit is suited to irrigated crops. Sprinkler irrigation is a suitable method of applying water. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

114C—Walla Walla silt loam, 7 to 12 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,000 to 2,300 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is brown and pale brown silt loam about 38 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam.

Included in this unit are small areas of Anderly and Hermiston soils, Walla Walla soils that have a hardpan at a depth of 40 to 60 inches or are eroded, and Vitrandepts. Also included are small areas of Walla Walla soils that have slopes of 1 to 7 percent or 12 to 20 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Walla Walla soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for nonirrigated peas, for irrigated small grain and alfalfa hay, and as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion. A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable to include in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. To reduce erosion and increase conservation of soil moisture on this unit, reduce the distance between terraces and leave more crop residue on the surface.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitation is the moderate hazard of water erosion. Sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning all crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass.

115D—Walla Walla silt loam, 12 to 25 percent north slopes. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 1,000 to 2,300 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is brown and pale brown silt loam about 38 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam.

Included in this unit are small areas of Anderly soils and Walla Walla soils that have a hardpan at a depth of

40 to 60 inches or are eroded. Also included are small areas of Walla Walla soils that have slopes of 1 to 12 percent or 25 to 40 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Walla Walla soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for wildlife habitat and rangeland.

This unit is suited to nonirrigated crops. It is limited mainly by the high hazard of water erosion.

A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable to include in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. To reduce erosion and increase conservation of soil moisture on this unit, reduce the distance between terraces and leave more crop residue on the surface. Because of slope, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is Idaho fescue and bluebunch wheatgrass.

115E—Walla Walla silt loam, 25 to 40 percent north slopes. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 1,000 to 2,300 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is brown and pale brown silt loam about 38 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas the surface layer is very fine sandy loam or fine sandy loam.

Included in this unit are small areas of volcanic ash. Also included are small areas of Walla Walla soils that are deep to a hardpan or are eroded and small areas of Walla Walla soils that have slopes of 12 to 25 percent or more than 40 percent. Included areas make up about 25 percent of the total acreage.

Permeability of this Walla Walla soil is moderate. Available water capacity is about 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used as rangeland and wildlife habitat. The unit is limited mainly by slope and the high hazard of water erosion.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitation for seeding is slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Use of mechanical treatment practices in some areas may not be practical because of the steepness of slope.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

116D—Walla Walla silt loam, 12 to 25 percent south slopes. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 1,000 to 2,300 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is brown and pale brown silt loam about 38 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam.

Included in this unit are small areas of Anderly soils and Walla Walla soils that have a hardpan at a depth of 40 to 60 inches or are eroded. Also included are small areas of Walla Walla soils that have slopes of 1 to 12 percent or 25 to 40 percent. Included areas make up about 30 percent of the total acreage.

Permeability of this Walla Walla soil is moderate. Available water capacity is about 10 to 14 inches.

Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for nonirrigated small grain. A few areas are used as wildlife habitat and rangeland.

This unit is suited to nonirrigated crops. It is limited mainly by the high hazard of water erosion and droughtiness.

A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable to include in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass.

117D—Walla Walla silt loam, 12 to 25 percent south slopes, eroded. This deep, well drained soil is on hillslopes. It formed in loess. Elevation is 1,000 to 2,300 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 170 days.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is pale brown silt loam about 30 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas that have been severely eroded, a hardpan is at a depth of 20 to 60 inches.

Included in this unit are small areas of Walla Walla soils that have not been eroded. Also included are small areas of Walla Walla soils that have slopes of 1 to 12 percent or 25 to 40 percent. Included areas make up about 50 percent of the total acreage.

Permeability of this Walla Walla soil is moderate. Available water capacity is about 8 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for wildlife habitat and rangeland.

This unit is suited to nonirrigated crops. It is limited mainly by the high hazard of water erosion and droughtiness.

Most areas of this unit are suited to a grain-fallow cropping system; however, precipitation may be adequate in some areas for 2 to 3 years of annual cropping followed by 1 year of fallow. Because much of the surface layer has been lost through erosion, green manure crops such as vetch, peas, and alfalfa can be included in the cropping system. Areas that are severely eroded should be planted to permanent grass or grass-legume mixtures. Proper management practices help to improve tilth, organic matter content, and water intake rate and to reduce erosion.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Reducing the distance between terraces also helps to reduce erosion and increase conservation of soil moisture. Because of slope, gradient terraces rather than level ones may be more suitable.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass.

118B—Walla Walla silt loam, hardpan substratum, 1 to 7 percent slopes. This deep, well drained soil is on broad summits of hills. It formed in loess. Elevation is 1,200 to 1,500 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 50 to 53 degrees F, and the average frost-free period is 135 to 165 days.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is brown and pale brown silt loam about 36 inches thick. The substratum is

very pale brown silt loam about 11 inches thick over a hardpan. Depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Pilot Rock and Walla Walla soils. Also included are small areas of Walla Walla soils that have slopes of 7 to 12 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Walla Walla soil is moderate. Available water capacity is about 7 to 12 inches. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used for nonirrigated peas, alfalfa hay, and pasture, for irrigated alfalfa hay and small grain, and as rangeland.

This unit is suited to nonirrigated crops. It is limited by the moderate hazard of water erosion and depth to the hardpan. A grain-fallow cropping system is used on most of this unit; however, in some areas precipitation is adequate for 2 to 3 years of annual cropping if followed by fallow. Winter and spring small grain and peas are suitable to include in the cropping system.

The main needs in cropland management are to protect the soil from water erosion and to conserve soil moisture for plant growth.

Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. All tillage should be on the contour or across the slope. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan.

Practices that can be used to control erosion include seeding early in the fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

The hardpan may interfere with the construction of certain types of terraces and diversions.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

If this unit is used for irrigated crops, the main limitation is the hazard of water erosion. Sprinkler irrigation is a suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and increasing the risk of erosion, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit is suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Fertilizer is needed to ensure optimum growth of grasses and legumes.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass.

119A—Wanser loamy fine sand, 0 to 3 percent slopes. This deep, poorly drained soil is in depressional areas on strath terraces of the Columbia River. It formed in sand derived from mixed sources. Elevation is 300 to 750 feet. The average annual precipitation is 8 to 9 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown loamy fine sand about 4 inches thick. The upper 34 inches of the substratum is brown and light brown loamy fine sand and fine sand, the next 6 inches is light brownish gray sand, and the lower part to a depth of 60 inches or more is pale brown fine sand. In some areas the surface layer is fine sand.

Included in this unit are small areas of Adkins, wet, soils; Burbank soils; Quincy, gravelly substratum, soils; and Winchester soils. Also included are small areas of soils that are similar to this Wanser soil but have a gravelly substratum at a depth of 10 to 60 inches. Included areas make up about 30 percent of the total acreage.

Permeability of this Wanser soil is rapid. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches for water-tolerant plants but is limited to depths between 6 and 40 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding. The hazard of soil blowing is high. A seasonal high water table is at a depth of 6 to 36 inches in May through November. This soil contains large amounts of sodium.

Most areas of this unit are used for irrigated hay and pasture. A few areas are used for homesite and recreational development and as rangeland.

If this unit is used for hay and pasture, the main limitations are wetness, excess sodium, and the high hazard of soil blowing.

This unit is below irrigation canals and has become wet from canal seepage and irrigation. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricting grazing to the drier areas

of this unit help to keep the pasture in good condition and to protect the soil from erosion. Grazing the areas that are very wet may result in compaction of the surface layer, poor tilth, and excessive erosion.

The soil in this unit has a water table during the growing season and is subirrigated in most areas; however, if supplemental irrigation is necessary, sprinkler systems are suited. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating, raising the water table, and leaching plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

If gravity irrigation systems are used, water should be applied at frequent intervals and runs should be short. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain or corn. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth. Most climatically adapted crops can be grown on this unit if artificial drainage is provided and the excess salts are eliminated.

In some areas the concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the high water table. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting. Tile or open drains can be used to remove excess water and provide an outlet for leached salts. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

Soil blowing generally is not a problem when the soil in this unit is in permanent pasture; however, when the plant cover is removed by tillage or for other reasons, the soil is highly susceptible to soil blowing. Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Russian-olive, Lombardy poplar, and caragana.

If this unit is used for homesite or recreational development, the main limitations are wetness, the high hazard of soil blowing, and the rare periods of flooding.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed during construction. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

The high water table increases the possibility of failure of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

If this unit is used as building sites, drainage or special design may be needed to overcome the limitation imposed by the high water table.

The potential plant community on this unit is mainly sedge, inland saltgrass, and alkali bluegrass.

120C—Wanser-Quincy complex, 0 to 12 percent slopes. This map unit is in depressional areas on strath terraces of the Columbia River. Elevation is 300 to 750 feet. The average annual precipitation is 8 to 9 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is 50 percent Wanser loamy fine sand and 35 percent Quincy fine sand. The percentage varies from one area to another. The Quincy soils have been blown in from the surrounding areas. They are in convex, dunelike areas and have slopes of 3 to 12 percent. The dunes are long and narrow and are oriented in a northeast-to-southwest direction. The Wanser soils are in the troughs between the Quincy soils and have slopes of 0 to 3 percent.

Included in this unit are small areas of Adkins, wet, soils and Pedigo soils. Included areas make up about 15 percent of the total acreage.

The Wanser soil is deep and poorly drained. It formed in sand derived from mixed sources. Typically, the surface layer is brown loamy fine sand about 4 inches thick. The upper 34 inches of the substratum is brown and light brown loamy fine sand and fine sand, the next 6 inches is light brown gray sand, and the lower part to a depth of 60 inches or more is pale brown fine sand.

Permeability of the Wanser soil is rapid. Available water capacity is about 3 to 6 inches. Effective rooting depth is 60 inches for water-tolerant plants but is limited to depths between 6 and 36 inches for non-water-tolerant plants. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. A seasonal high water table is at a depth of 6 to 36 inches in May through November. This soil contains large amounts of sodium.

The Quincy soil is deep and excessively drained. It formed in eolian sand. Typically, the surface layer is grayish brown fine sand about 4 inches thick. The upper 23 inches of the substratum is grayish brown loamy fine sand, the next 12 inches is gray fine sand, and the lower part to a depth of 60 inches or more is light brownish gray fine sand. In some areas the surface layer is loamy fine sand.

Permeability of the Quincy soil is rapid. Available water capacity is about 2.5 to 5.0 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Most areas of this unit are used for irrigated pasture. A few areas are used for wildlife habitat and rangeland.

If this unit is used for pasture, the main limitations are the wetness and excess sodium content of the Wanser soil and the very high hazard of soil blowing in areas of the Quincy soil. This unit is below irrigation canals and in depressional areas and has become wet from canal seepage and irrigation. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Proper stocking rates, pasture rotation, and restricted grazing during periods that are too wet or too dry help to keep the pasture in good condition and to protect the soil from erosion. Grazing those areas that are very wet may result in compaction of the surface layer, poor tilth, and excessive erosion.

The Wanser soil has a high water table during the growing season and is subirrigated in most areas; however, if supplemental irrigation is necessary, flood or sprinkler systems can be used. Use of sprinkler systems permits the even, controlled application of water. To avoid overirrigating, raising the water table, and leaching plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Because the topography of this unit is hummocky, flood irrigation usually does not permit the uniform application of water. For the efficient application and removal of irrigation water, leveling is needed in hummocky areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The concentration of salts and alkali in the surface layer of the Wanser soil limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the water table. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting. Tile or open drains can be used to remove excess water and provide an outlet for leached salts. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

Soil blowing generally is not a problem when this unit is in permanent pasture; however, the Quincy soil is highly susceptible to soil blowing when it is not protected by plant cover. Practices that can be used to reduce soil blowing are properly timing irrigation, growing winter cover crops, and establishing windbreaks. Among the trees and shrubs that are suitable for windbreaks are Russian-olive, Rocky Mountain juniper, and lilac. Blowout areas can be treated by disking in straw and seeding adapted grasses.

The potential plant community on the Wanser soil is mainly sedge and saltgrass. The potential plant community on the Quincy soil is bitterbrush, needleandthread, and ricegrass.

121B—Willis silt loam, 2 to 7 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess deposited over cemented alluvium. Elevation is 1,000 to 1,600 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 50 to 51 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The upper 20 inches of the subsoil is brown silt loam, and the lower 6 inches is pale brown silt loam over a cemented hardpan. Depth to the cemented hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Mikkalo and Ritzville soils. Also included are small areas of Willis soils that have slopes of 7 to 12 percent and soils that are similar to this Willis soil but are 40 to 60 inches deep to a hardpan. Included areas make up about 20 percent of the total acreage.

Permeability of the Willis soil is moderate to a depth of 33 inches and very slow below this depth. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to the hardpan, the moderate hazard of water erosion, and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the unit from water erosion and soil blowing and to conserve moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, terraces are constructed, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Terraces reduce gully erosion and conserve soil moisture. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing,

and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Other practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Austrian pine, and Tatarian honeysuckle.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

121C—Willis silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess deposited over cemented alluvium. Slopes face south and west. Elevation is 1,000 to 1,600 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 50 to 51 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The upper 20 inches of the subsoil is brown silt loam, and the lower 6 inches is pale brown silt loam over a cemented hardpan. Depth to the cemented hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Mikkalo and Ritzville soils. Also included are small areas of Willis soils that have slopes of 2 to 7 percent or 12 to 30 percent and soils that are 40 to 60 inches deep to a hardpan. Included areas make up about 20 percent of the total acreage.

Permeability of the Willis soil is moderate to a depth of 33 inches and very slow below this depth. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas of this unit are used for nonirrigated small grain. A few areas are used as rangeland and wildlife habitat.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to the hardpan, the moderate hazard of water erosion, and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, terraces are constructed, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Other practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, stripcropping, and conducting tillage and other farming operations at a right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Austrian pine, and Tatarian honeysuckle.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion and increase conservation of soil moisture on this unit, reduce the distance between terraces and leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall and the moderate hazard of soil blowing. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion.

121D—Willis silt loam, 12 to 30 percent slopes. This moderately deep, well drained soil is on terrace scarps. It formed in loess deposited over cemented alluvium. Slopes face south and west. Elevation is 1,000 to 1,600 feet. The average annual precipitation is 11 to 12 inches, the average annual air temperature is 50 to 51 degrees F, and the average frost-free period is 150 to 170 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The upper 20 inches of the subsoil is brown silt loam, and the lower 6 inches is pale brown silt loam over a cemented hardpan. Depth to the cemented hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Lickskillet, Mikkalo, and Ritzville soils. Also included are small areas of Willis soils that have slopes of 7 to 12 percent and soils that are 40 to 60 inches deep to a hardpan. Included areas make up about 35 percent of the total acreage.

Permeability of the Willis soil is moderate to a depth of 33 inches and very slow below this depth. Available water capacity is about 4 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for nonirrigated small grain.

The potential plant community on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low rainfall and low natural fertility. If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are low rainfall, the moderate hazard of soil blowing, and slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices may be limited in the steeper parts of this unit.

This unit is suited to nonirrigated crops. It is limited by the moderate depth to the hardpan, the high hazard of water erosion, and the hazard of soil blowing. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

The main needs in cropland management are to protect the soil from water erosion and soil blowing and to conserve soil moisture for plant growth.

Erosion is reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content.

Limiting tillage for seedbed preparation and weed control conserves moisture and reduces the susceptibility of the soil to blowing. A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling can be used to break up the pan. Other practices that can be used to reduce soil blowing are establishing windbreaks, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and

shrubs can be grown for windbreaks. Among the trees and shrubs that are suitable are Lombardy poplar, Rocky Mountain juniper, and Tatarian honeysuckle.

On long slopes, chiseling the stubble in fall slows runoff and reduces soil loss in years when the snow melts rapidly while the soil is still frozen. Chiseling also promotes better aeration.

To reduce erosion on this unit, leave more residue on the surface.

Crops respond to nitrogen, phosphorous, and sulfur fertilizer.

122B—Winchester sand, 0 to 5 percent slopes. This deep, excessively drained soil is on strath terraces of the Columbia River. It formed in eolian sand. Elevation is 400 to 1,200 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

Typically, the surface layer is brown sand about 10 inches thick. The substratum to a depth of 60 inches or more is dark gray coarse sand. In some areas the surface layer is loamy coarse sand or coarse sand.

Included in this unit are small areas of Dune land and Quincy and Wanser soils. Also included are small areas of soils that are similar to this Winchester soil but that have gravel at a depth of 40 to 60 inches and small areas of Winchester soils that have slopes of 5 to 15 percent. Included areas make up about 20 percent of the total acreage.

Permeability of this Winchester soil is rapid. Available water capacity is about 2.5 to 3.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Most areas of this unit are used for irrigated crops such as Irish potatoes, small grain, and alfalfa hay. Among the other crops grown are corn for grain and silage. Some areas are used for pasture, for homesite and recreational development, and as rangeland and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, rapid permeability, and the very high hazard of soil blowing.

Because the water intake rate is high, sprinkler or drip irrigation is best suited to this unit. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. These include Lombardy poplar, Rocky Mountain juniper, and lilac.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too dry may increase the risk of soil blowing.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, and antelope bitterbrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soil in this unit is susceptible to displacement when dry, grazing should be done when the soil is moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the very high hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of

erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Population growth has resulted in increased construction of homes on this unit. The main limitations are the very high hazard of soil blowing, low rainfall, and rapid permeability.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

123B—Winchester-Quinton complex, 0 to 5 percent slopes. This map unit is on strath terraces of the Columbia River. Elevation is 600 to 900 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is 50 percent Winchester sand and 35 percent Quinton loamy fine sand. The percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them at the scale used.

Included in this unit are small areas of Starbuck and Quincy soils. Also included are small areas of Rock outcrop and Dune land. Included areas make up about 15 percent of the total acreage.

The Winchester soil is deep and excessively drained. It formed in eolian sand. Typically, the surface layer is brown sand about 10 inches thick. The substratum to a depth of 60 inches or more is dark gray coarse sand. In some areas the surface layer is loamy coarse sand or coarse sand. In some areas depth to bedrock ranges from 40 to 60 inches.

Permeability of the Winchester soil is rapid. Available water capacity is about 2.5 to 3.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

The Quinton soil is moderately deep and excessively drained. It formed in eolian sand. Typically, the surface layer is dark grayish brown loamy fine sand about 6 inches thick. The upper 12 inches of the substratum is brown loamy fine sand, the next 11 inches is grayish brown loamy fine sand, and the lower part to a depth of 35 inches is grayish brown gravelly loamy fine sand. Basalt is at a depth of 35 inches. Depth to basalt ranges from 20 to 40 inches. In some areas basalt is at a depth of 40 to 60 inches. In some areas the surface layer is fine sand or sand.

Permeability of the Quinton soil is rapid. Available water capacity is about 1.5 to 3.0 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Most areas of this unit are used for irrigated crops such as Irish potatoes, small grain, and alfalfa hay. Among the other crops grown are corn for grain and silage. Some areas are used as rangeland, pasture, and wildlife habitat.

This unit is suited to irrigated crops. It is limited mainly by low natural fertility, low available water capacity, the hazard of soil blowing, and the moderate depth to bedrock in the Quinton soil.

Because the water intake rate is high, sprinkler or drip irrigation is best suited to this unit. Center pivot systems commonly are used. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Also, because of the difference in the depth to bedrock in the two soils in this unit, ponding may result in areas of the Quinton soil. Because this unit is droughty, applications of irrigation water should be light and frequent. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 3 or 4 years of small grain, corn, or potatoes. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth.

Practices that can be used to reduce soil blowing are establishing windbreaks, growing winter cover crops, using minimum tillage, properly timing irrigation, keeping the soil rough and cloddy when it is not protected by plant cover, and conducting tillage and other farming operations at right angle to the prevailing wind. Blowout areas can be treated by disking in straw and seeding adapted grasses. If irrigation is used, most climatically adapted trees and shrubs can be grown for windbreaks. These include Lombardy poplar, Rocky Mountain juniper, and lilac.

If this unit is used for pasture, proper stocking rates and pasture rotation help to keep the pasture in good condition. Grazing when the soil is too dry may result in excessive soil blowing.

Sprinkler irrigation is a suitable method of applying water. Water should be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

The potential plant community on this unit is mainly needleandthread, Indian ricegrass, and antelope bitterbrush. The production of forage is limited by low rainfall and low natural fertility.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The risk of soil blowing increases significantly if this unit is overgrazed. Because the soils in this unit are susceptible to displacement when dry, grazing should be done when the soils are moist to reduce soil blowing and damage to forage plants. In general, winter is the best season for grazing.

Rangeland seeding is suitable if the rangeland is in poor condition. The main limitations for seeding are the hazard of soil blowing and low rainfall. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Brush management improves deteriorated areas of rangeland that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

124B—Winchester-Urban land complex, 0 to 5 percent slopes. This map unit is on strath terraces of the Columbia River. Elevation is 400 to 500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

This unit is 60 percent Winchester sand and 25 percent Urban land.

Included in this unit are small areas of Adkins, Quincy, and Wanser soils. Included areas make up about 15 percent of the total acreage.

The Winchester soil is deep and excessively drained. It formed in eolian sand. Typically, the surface layer is brown sand about 10 inches thick. The substratum to a depth of 60 inches or more is dark gray coarse sand. Basalt is at a depth of 60 inches or more.

Permeability of the Winchester soil is rapid. Available water capacity is about 2.5 to 3.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is very high.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

This unit is used for urban and homesite development.

Population growth has resulted in increased construction of homes on this unit. The main limitations are the rapid permeability, low rainfall, and the very high hazard of soil blowing.

Excavation for houses and access roads in places exposes material that is highly susceptible to soil blowing. Revegetating disturbed areas around construction sites as soon as feasible helps to control soil blowing.

Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Plant cover can be established and maintained through proper fertilizing, seeding, mulching, and shaping of the slopes.

If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This unit is well suited to windbreaks and environmental plantings. The main limitations are low rainfall, low available water capacity, and the very high hazard of soil blowing. Establishment of tree seedlings may be difficult because of these limitations. Supplemental irrigation may be needed when planting and during dry periods.

Among the trees that are suitable for planting are Russian-olive and Rocky Mountain juniper. Among the shrubs are lilac. If irrigation is used, most climatically adapted shrubs and trees can be grown.

125F—Wrentham-Rock outcrop complex, 35 to 70 percent slopes. This map unit is on hillslopes. Slopes are convex and generally are north- or east-facing. Elevation is 900 to 3,000 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 45 to 52 degrees F, and the average frost-free period is 100 to 150 days.

This unit is 40 percent Wrentham silt loam and 25 percent Rock outcrop. The percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Anderly, Bakeoven, Condon, Lickskillet, and Nansene soils. Also included are small areas of Wrentham soils that have slopes of 20 to 35 percent. Included areas make up about 35 percent of the total acreage.

The Wrentham soil is moderately deep and well drained. It formed in loess and colluvium. Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is dark brown and brown gravelly and very gravelly silt loam about 23 inches thick. Basalt is at a depth of 33 inches. Depth to basalt ranges from 20 to 40 inches. In some areas depth to basalt ranges from 40 to 60 inches.

Permeability of the Wrentham soil is moderately slow. Available water capacity is about 3 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop consists of areas of exposed basalt.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue and bluebunch wheatgrass. The production of forage is limited by the high content of rock fragments in the soil.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Mechanical treatment is not practical, because the surface is stony and the slopes are steep.

Steepness of slope and rock outcroppings limit access by livestock and promote overgrazing of the less sloping areas. Trails or walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

126A—Xerofluvents, 0 to 3 percent slopes. These deep, somewhat poorly drained to excessively drained soils are on flood plains. They formed in mixed alluvium. Elevation is 250 to 3,000 feet. The average annual precipitation is 8 to 30 inches, the average annual air temperature is 45 to 54 degrees F, and the average frost-free period is 110 to 190 days.

The characteristics of Xerofluvents are variable. The surface layer ranges from loamy sand to very cobbly loam or silt loam. The underlying layer ranges from extremely gravelly or extremely cobbly sand to very cobbly or very gravelly loam.

Included in this unit are small areas of Esquatzel, Freewater, Hermiston, Kimberly, Veazie, and Yakima soils and Riverwash. The percentage varies from one area to another.

Permeability of these Xerofluvents is moderate to very rapid. Available water capacity is variable. Effective rooting depth is 20 to 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table may be at the surface to a depth of more than 60 inches below the surface throughout the year. This soil is subject to brief to long periods of flooding in winter and spring.

Most areas of this unit are used for pasture and wildlife habitat. A few areas are used as homesites.

If this unit is used for pasture, the main limitations are the hazard of flooding and the high content of rock fragments in the soil.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is wet may result in compaction of the surface layer, poor tilth, and excessive runoff. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill.

This unit is flooded frequently, and unless it is protected by levees or other flood control structures, damage to the pasture will occur.

Cobbles on the surface limit the use of equipment and increase maintenance costs.

If this unit is used for homesite development, the main limitations are the hazard of flooding, the very rapid permeability of the substratum in some areas, and the seasonal high water table.

Because of the seasonal high water table, drainage should be provided if buildings with basements are constructed. Wetness can be reduced by installing drain tile around footings.

Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this problem.

It is difficult to establish plants in areas where the surface layer has been removed, exposing the substratum. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

The very rapid permeability of the substratum in some areas and the seasonal high water table adversely affect the purification process of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

127F—Xerollic Durorthids, 30 to 60 percent slopes. These shallow to moderately deep, well drained soils are on terrace scarps. They formed in loess over cemented

alluvium. Elevation is 800 to 1,200 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 160 to 190 days.

The surface layer ranges from fine sandy loam to very cobbly silt loam. The underlying layer ranges from very gravelly loam to very fine sandy loam. A cemented hardpan is at a depth of 10 to 40 inches.

Permeability of these Xerollic Durorthids is moderate to a depth of 10 to 40 inches and very slow below this depth. Available water capacity is variable. Effective rooting depth is 10 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used as rangeland and wildlife habitat.

The potential plant community on this unit varies; however, plants that may occur in the community include needleandthread, bluebunch wheatgrass, and Sandberg bluegrass. The production of forage is limited by the shallow depth to the hardpan, the high content of rock fragments in the soil, and low rainfall.

If the rangeland is overgrazed, the proportion of preferred forage plants decreases and that of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, a planned grazing system, and brush management. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater risk of erosion. Use of mechanical treatment practices generally is not practical because of the steepness of slope.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in some places to encourage livestock to graze in areas where access is limited.

128A—Yakima silt loam, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. It formed in mixed alluvium. Elevation is 600 to 1,600 feet. The average annual precipitation is 9 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 145 to 195 days.

Typically, the surface layer is dark grayish brown and brown silt loam about 10 inches thick. The subsurface layer is brown silt loam about 12 inches thick. The substratum to a depth of 60 inches or more is brown extremely gravelly loamy sand and sand. Depth to the substratum ranges from 20 to 40 inches. Some areas have a gravelly loam or cobbly loam surface layer.

Included in this unit are small areas of Freewater, Hermiston, and Onyx soils and Xerofluvents. Also included are small areas of soils that are similar to this Yakima soil but have a gravelly substratum at a depth of 40 to 60 inches and small areas of Yakima soils that have a water table above four feet. Included areas make up about 20 percent of the total acreage.

Permeability of this Yakima soil is moderate to a depth of 24 inches and very rapid below this depth. Available water capacity is about 2.5 to 7.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

This unit is used mainly for irrigated crops such as small grain and alfalfa hay (fig. 10). It is also used for pasture, rangeland, row crops, tree fruit, and homesite development.

This unit is suited to irrigated crops. It is limited mainly by the very rapid permeability and low available water capacity of the substratum.

Furrow, border, corrugation, drip, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop. If furrow or corrugation irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. If gravity systems are used, leveling may be needed in sloping areas for the efficient application and removal of irrigation water. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. A suitable cropping system is one that includes 4 or 5 years of alfalfa hay and 2 years of small grain.

If this unit is used for hay and pasture, the main limitations are the very rapid permeability and low available water capacity of the substratum.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

Irrigation water can be applied by the flood and sprinkler methods. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen, phosphorous, and sulfur fertilizer are needed to maintain production of high quality irrigated pasture.

If this unit is used for homesite development, the main limitations are the rare periods of flooding and the very rapid permeability of the substratum.

It is difficult to establish plants in areas where the surface and subsurface layers have been removed, exposing the gravelly substratum. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

Figure 10.—Alfalfa hay in an area of Yakima silt loam, 0 to 3 percent slopes, along the Umatilla River.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping. To prevent cutbanks from caving in, excavations may require special retainer walls.

The very rapid permeability of the substratum adversely affects the purification process of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Culverts may become clogged during floods, and damage to roads, homesites, and structures may result. Using larger culverts helps to overcome this problem.

The potential plant community on this unit is mainly bluebunch wheatgrass, basin wildrye, and big sagebrush.

129A—Yakima-Urban land complex, 0 to 3 percent slopes. This map unit is on flood plains. Elevation is 800 to 1,200 feet. The average annual precipitation is 13 to 14 inches, the average annual air temperature is 51 to 53 degrees F, and the average frost-free period is 160 to 170 days.

This unit is 60 percent Yakima silt loam and 25 percent Urban land.

Included in this unit are small areas of Freewater, Onyx, and Hermiston soils. Included areas make up about 15 percent of the total acreage.

The Yakima soil is deep and well drained. It formed in mixed alluvium. Typically, the surface layer is dark grayish brown and brown silt loam about 10 inches thick. The subsurface layer is brown silt loam about 12 inches thick. The substratum to a depth of 60 inches or more is brown extremely gravelly loamy sand and sand. Depth to the substratum ranges from 20 to 40 inches.

Permeability of the Yakima soil is moderate to a depth of 24 inches and very rapid below this depth. Available water capacity is about 2.5 to 7.5 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

This unit is used for urban and homesite development.

The main limitations of this unit for use as urban and homesite development are the rare periods of flooding and the very rapid permeability of the substratum. The unit is protected by major flood control structures such as dikes and levees.

It is difficult to establish plants in areas where the surface and subsurface layers have been removed, exposing the gravelly substratum. Mulching and fertilizing cut areas help to establish plants. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

If the soil in this unit is used as a base for roads and streets, the upper part of the soil can be mixed with the underlying sand and gravel to increase its strength and stability. Cutbanks are not stable and are subject to slumping.

The very rapid permeability of the substratum adversely affects the purification process of septic tank absorption fields. If the density of housing is high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

Prime Farmland

In this section, prime farmland is defined and discussed and the prime farmland soils in this survey area are listed.

Prime farmland is of major importance in providing the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, seed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. Adequate moisture and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food and fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils commonly get an adequate and dependable supply of moisture from precipitation or irrigation. Temperature and length of growing season are favorable, and level of acidity or alkalinity is acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not flooded during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table, are subject to flooding, or are droughty may qualify as prime farmland soils if the limitations are overcome by drainage, flood control, or irrigation. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 296,290 acres, or nearly 18 percent, of the survey area would meet the requirements for prime farmland if an adequate and dependable supply of irrigation water were available.

The following map units meet the soil requirements for prime farmland when irrigated. On some soils included in the list, measures should be used to overcome a hazard or limitation, such as flooding, wetness, or droughtiness. The location of each map unit is shown on the detailed soil maps at the back of this publication. Soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

1B Adkins fine sandy loam, 0 to 5 percent slopes
2B Adkins fine sandy loam, gravelly substratum, 0 to 5 percent slopes
8B Athena silt loam, 1 to 7 percent slopes
16B Cantala silt loam, 1 to 7 percent slopes
27A Esquatzel silt loam, 0 to 3 percent slopes
39A Hermiston silt loam, 0 to 3 percent slopes
42A Kimberly fine sandy loam, 0 to 3 percent slopes
43A Kimberly silt loam, 0 to 3 percent slopes
55A Mondovi silt loam, 0 to 3 percent slopes
61A Oliphant silt loam, 0 to 3 percent slopes
63A Onyx silt loam, 0 to 3 percent slopes
64B Palouse silt loam, 1 to 7 percent slopes
72A Powder silt loam, 0 to 3 percent slopes
79B Ritzville very fine sandy loam, 2 to 7 percent slopes
80B Ritzville silt loam, 2 to 7 percent slopes
96B Thatuna silt loam, 1 to 7 percent slopes
109A Veazie silt loam, 0 to 3 percent slopes
114B Walla Walla silt loam, 1 to 7 percent slopes
118B Walla Walla silt loam, hardpan substratum, 1 to 7 percent slopes
128A Yakima silt loam, 0 to 3 percent slopes

Unique Farmland

Unique farmland soils are soils other than prime farmland soils that are used for the production of specific high-value food and fiber crops. These soils have a special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained yields of high-quality crops or specialty crops when treated or managed according to acceptable farming methods. Some of the orchard soils in the Milton-Freewater area are unique farmland soils. They have an available water capacity that is adequate for growing tree fruit when irrigated. These soils have the advantage of growing season, temperature, humidity, air drainage, elevation, and nearness to market that favor growth of tree fruit.

28A Freewater gravelly silt loam, 0 to 3 percent slopes
29A Freewater very cobbly loam, 0 to 3 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for nonirrigated and irrigated crops and for hay and pasture is suggested in this section. The system of land capability classification used by the Soil Conservation Service is explained, and the estimated yields of the main crops and hay and pasture plants commonly grown are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Nonirrigated Cropland

Gene Sturtevant, soil conservationist, Soil Conservation Service, and Luther Fitch, county agent, Cooperative Extension Service, helped to prepare this section.

The Umatilla County Area has about 600,000 acres that is used for nonirrigated crops, mainly small grain. Erosion by water and wind and inadequate moisture for plant growth are the biggest concerns in managing this cropland. For each detailed soil map unit, a management system needs to be used that will keep soil and moisture losses to a minimum. A management system for a particular farm can include a combination of management practices.

Gully, sheet, and rill erosion are serious problems affecting nonirrigated cropland. These types of erosion result in loss of valuable topsoil, sedimentation, poor water quality, and, in some cases, damage to personal property. Insufficient moisture limits production of nonirrigated crops; therefore, it is important to conserve and use efficiently all the moisture that is available.

If the surface layer is lost through erosion, much of the available plant nutrients and organic matter, which have positive effects on structure, water infiltration, and general tilth, are also lost. The severity of the erosion determines how much of the potential productivity of the soils is lost and for how long. Many years may be needed to replace a part of the soil surface, even under the best of soil building conditions. Examples of severely eroded soils in the survey area are the eroded phases of the Walla Walla and Oliphant soils. Soils that have steep slopes, particularly those that have slopes of more than 25 percent, are highly susceptible to water erosion. Examples are some areas of Palouse and Walla Walla soils. Planting of steep slopes and areas of eroded soils to permanent vegetation is an effective method of minimizing water erosion and rehabilitating the eroded soils.

Soils are very susceptible to erosion when frozen. When a soil is frozen, the water intake rate is reduced significantly. This results in excessive runoff during freeze and thaw cycles. When the soil surface thaws it becomes saturated and flows downslope. The saturated soil consolidates and exudes water. The concentrated

flow of this water causes severe gully and rill erosion. Soils that are particularly subject to runoff caused by freezing and thawing are areas of the Palouse and Athena soils that have slopes of more than 10 percent.

Resource management systems that can reduce soil erosion by runoff and conserve soil moisture include appropriate cultural or residue management practices and structural practices. Residue management practices include conservation cropping systems, conservation tillage systems, stubble mulching, no-till farming, and chemical fallow. Structural practices include terraces, diversions, and grassed waterways. Contour and cross-slope tillage and stripcropping also reduce erosion and conserve soil moisture.

Organic matter residue is an important source of nitrogen, phosphorus, and sulfur for crops. It also increases water intake rate and water holding capacity, reduces surface crusting, promotes good soil structure and tilth, and reduces erosion. Research has shown that the organic matter content gradually decreases in soils that have been used for many years to grow small grain under a grain-fallow cropping system. This is the case even where straw or pea vines are incorporated. Adding this material in a conservation cropping system is important in slowing this decline. Only when manure is added regularly will the organic matter content be maintained or increased. Growing green manure crops or putting severely eroded areas in permanent vegetation hasten their rehabilitation.

Use of conservation tillage systems or minimum tillage is important in maintaining good soil tilth. Maintaining a rough and cloddy surface after plowing can reduce runoff. Excessive tillage results in loss of valuable soil moisture and pulverizes soil aggregates, destroying soil structure. Overworking the soil before seeding in spring and summer results in crusting. This reduces infiltration and produces a smooth soil surface, which causes excessive runoff and erosion.

Most of the soils in the nonirrigated cropland area are silt loam. When these soils are moist, they are particularly susceptible to compaction by farm machinery, vehicles, or livestock. Compaction reduces infiltration of water and restricts penetration of roots. Since movement of water within the soils is impeded, runoff is increased and erosion occurs. Minimizing tillage and restricting traffic from equipment and livestock when the soils are too moist reduce compaction. Subsoiling or deep chiseling when the soils are dry is the best method of destroying these compacted layers.

Proper management of residue involves several practices; however, the main goal is to leave as much plant material as practical on the soil surface throughout the year. Stubble mulching is a residue management practice in which crop residue is left on the surface to reduce erosion and soil moisture loss. Residue on the surface retards the start of erosion and filters out sediment from the runoff that does occur. Also, by decomposing it returns some organic matter to the soil, which improves soil structure and increases water infiltration. In the drier areas of the Shano and Ritzville soils, stubble mulching also reduces soil blowing.

In the past, when excess amounts of residue remained after harvest, the residue was removed by grazing, by mechanical means, or by burning. Grazing and straw removal are not very desirable, nor are they always economically feasible. Research has demonstrated that burning is detrimental to the soil. It results in crusting of the soil surface, which reduces infiltration and increases runoff and erosion.

Residue can be buried by plowing. Moldboard plowing inverts the soil surface and leaves little residue on the surface. Residue can be brought to the surface by subsequent chisel plowing. Straw can be partially buried by disking or chiseling, which accelerates the decomposition of the buried part yet retains sufficient residue on the surface.

The trend in nonirrigated crop management in recent years has been toward reduced tillage or no-till farming. No-till farming consists of planting crops in previously unprepared soil by opening a narrow furrow of sufficient width and depth to obtain proper seed coverage. Most cultivation is made unnecessary by the use of herbicides to kill weeds and grasses in the fallow year. This commonly is called chemical fallow.

No-till cropping is not new but is becoming very popular. Its continued popularity depends upon many things, including the future development and cost of equipment, fertilizer, and herbicides. Research on no-till and other conservation tillage systems and their effects on crop yields, diseases, the soil, and the environment is still continuing.

Terraces and diversions reduce the length of slopes and thereby reduce runoff, sedimentation, and erosion. They are most practical on soils that have uniform slopes. Terraces are most effective in reducing rill and sheet erosion on slopes of less than 12 percent. Where slopes are more than 12 percent, they commonly are effective only in reducing gully erosion.

Level and gradient terraces are the two types constructed on the nonirrigated cropland soils of the area. Level terraces generally are more effective on deep soils in areas of moderate precipitation, such as in areas of Athena and Walla Walla soils. Gradient terraces generally are constructed on moderately deep soils in areas of high precipitation, such as in areas of Gurdane and Waha soils.

Grassed waterways that are established with suitable vegetation are effective in reducing erosion and sedimentation in areas of concentrated waterflow. They can be used in areas where a natural or constructed waterway or outlet is present. The vegetation helps to keep the soil in place and makes it more resistant to the erosive forces of the water. It also acts as a filter, thus reducing the amount of sediment carried by runoff.

Stripcropping or the alternate arrangement of crop and fallow is an effective method of reducing soil blowing and water erosion. On soils such as those of the Shano and Ritzville series, which are susceptible to soil blowing, an alternate strip of live vegetation or residue can be used to retard the movement of soil particles by wind. These strips should be oriented at right angle to the prevailing wind direction. In areas of high precipitation, this practice is also effective in reducing water erosion and sedimentation. This is best suited on uniform slopes where strips can be easily laid out on the contour or across the slope.

A tillage practice that can be done in conjunction with stripcropping is contour or cross-slope tillage. The furrows made by the tillage operations act as miniature terraces to retard the downslope flow of water. This type of tillage is best suited to soils that have smooth, uniform slopes. Examples are the more gently sloping areas of the Condon and Morrow soils.

The main cropping system in the nonirrigated cropland area is small grain-fallow. The small grain crops most commonly planted are winter wheat and spring barley. In small grain-fallow nonirrigated farming, the soil is kept free of vegetation or is fallowed during one cropping season in order to store additional moisture and plant nutrients for a crop the following season and to allow time for mineralization of nitrogen from organic matter. This cropping system is used in areas of Shano and Ritzville soils that do not receive adequate moisture for annual cropping.

The practice of summer fallowing is recognized as a cause of water erosion, whether it be associated with prolonged rains, frozen soils, or the intense summer thunderstorms. Annual cropping could provide an alternative in certain cases.

In moderately deep soils such as the Condon and Morrow soils, where the profile commonly is filled by the precipitation falling in one season, annual cropping may reduce soil erosion. When precipitation is greater than normal, some deep soils such as the Walla Walla soils can be cropped 2 or 3 years in a row followed by a year of fallow. In soils such as those of the Athena and Palouse series, which receive more than 16 inches of precipitation annually, annual cropping is practiced with small grain and peas. An occasional year of fallow may be used for weed control or if winter precipitation is exceptionally low.

Soils on flood plains where precipitation is supplemented by subsurface water sources, such as the Veazie soils, and soils that receive adequate precipitation, such as the Cowsly soils, commonly are used to grow permanent grass or grass-legume pasture.

For high yields and top quality crops, a fertilizer program is needed for all of the soils in the survey area. Fertilizer is used to replace or supplement the soil's supply of elements required for plant nutrition. Elements that have shown a response in plant growth throughout the nonirrigated cropland area include nitrogen, phosphorus, and sulfur.

On all of the soils, the amount and kind of fertilizer used should be based on the results of soil tests, on the needs of the crop, and on the expected yields. The Agricultural Extension Service can help to determine the kind and amount of fertilizer to apply.

Irrigated Cropland

The Columbia Basin, in the northwestern part of Umatilla County, has more than 75,000 acres of irrigable or potentially irrigable land. Nearly 35,000 acres of this land has been brought under irrigation in the past 15 years. This acreage has been irrigated with water pumped from the Columbia River and from deep aquifers. Many of the management and cultural practices on these irrigated sands are still changing.

Most of this area is subject to soil blowing and requires certain practices that are important for successful crop production and to minimize soil blowing. Late in winter through early in summer is the period most susceptible to frequent, high velocity winds that create serious soil blowing hazards. Soils particularly subject to soil blowing include the Quincy and Winchester soils.

Plant cover or organic residue should be maintained on the soil surface as much of the time as is feasible. It is desirable to include alfalfa and, in some instances, grass-legume pasture in the cropping system to help build up the organic matter content of the soil and to protect the soil during most of the year. Commonly, cropping systems that include 3 to 5 years of alfalfa with every 3 to 5 years of small grain, corn, and potatoes are used.

Minimum tillage is an important management technique that can be used on soils in this survey area because it can result in more residue remaining on the soil surface and less degradation of soil structure and tilth.

Cultivation for weed control is difficult if there is a large amount of residue on the soil surface. An appropriate selective or nonselective herbicide, or both, is essential to minimum tillage or no-till farming. Usable and practical systems have not been developed for all crops; however, systems now exist for corn, sugar beets, carrots, watermelons, and potatoes.

Of the crops grown in this area, corn is perhaps best suited to minimum tillage or no-till farming because it is large and vigorous as a seedling and because there are many effective herbicides registered for use on corn. Procedures vary from planting directly in corn stubble from the previous year to planting in volunteer or fall seeded grain sod, following a nonselective herbicide application.

With crops such as carrots, sugar beets, and onions, alternating strips of seeded or volunteer grain running at right angle to the prevailing southwest winds have been

used to reduce soil blowing (fig. 11). Depending on the crop grown, the existing weeds can be killed with nonselective herbicides prior to planting or with selective herbicides after planting.

Tillage implements, if used, are designed or adapted to leave residue on the surface. Sweeps, chisels, and other implements that do not invert or pulverize the soil are preferred. Tillage should be conducted at right angle to the prevailing wind direction. The furrows formed by the operations act as miniwindbreaks that retard the movement of particles along the soil surface.

Using volunteer small grain as fall pasture in the survey area is a common practice. Increasing numbers of livestock producers are using the Columbia Basin as a winter pasturing ground. Turnips, seeded after winter wheat, early potatoes, and dry peas, provide more than two times as much fall and winter livestock carrying capacity as does volunteer or seeded small grain. Cornstalks left standing when harvesting corn are used as fall and winter pasture.

Not only does irrigation water supply crops with needed moisture, it can be used to reduce soil blowing if applied properly and at the right time. Moist soil particles tend to adhere together and are more resistant to soil blowing. Also, if the soil is tilled when moist the surface is more likely to remain rough and cloddy.

Irrigation methods in this area vary from center pivot sprinkler systems to wild flooding. Presently, sprinkler systems are the ones most commonly used; however, there is a growing interest in drip irrigation of suitable crops. Low pressure center pivot systems are becoming more popular because of energy costs.

Center pivot and drip irrigation systems are particularly well suited to sandy soils such as those of the Quincy and Winchester series, which have rapid permeability, high water intake rate, and low available water capacity. The frequency, duration, and amount of water applied can be controlled with little labor if a center pivot system is used. Using hand line and wheel line sprinkler systems on these droughty soils, it is difficult to apply irrigation water at the frequency needed for optimum plant growth. Hand line and wheel line systems work well on soils that have a relatively lower water intake rate, slower permeability, and higher available water capacity. Soils that have a silt loam surface layer commonly are irrigated with wheel and hand lines.

On the Columbia Plateau, water is pumped primarily from deep aquifers in the Columbia River Basalt. The upland areas near the towns of Pilot Rock and Athena

Figure 11.—Strips of seeded grain running at right angle to the prevailing wind to reduce soil loss and crop damage as a result of soil blowing.

are irrigated with center pivot, wheel, and hand line sprinkler systems. Low pressure center pivot systems that are adjusted to the relatively low water intake rate of silt loams are being used in the Athena area. These systems can be used to make light and frequent applications of irrigation water. In most instances the slopes of these upland soils are steeper than those on the flood plains; thus, it is important to manage the application of irrigation water carefully so as to minimize runoff and erosion.

The Hermiston and Yakima soils are irrigated using hand and wheel line sprinkler systems and gravity systems, such as border and furrow systems, depending upon the crop grown. These flood plain soils generally are not so subject to runoff as are the adjacent upland soils. Irrigation water management is still needed to prevent overirrigation or underirrigation, leaching of plant nutrients, and creation of a water table.

Crops grown on the Columbia Plateau include alfalfa, pasture, small grain, dry beans and peas, green peas, and legume seed.

Irrigated crops have been grown in the Milton-Freewater area for more than 50 years. The Ellisforde and Oliphant soils are used to produce alfalfa seed, small grain, and peas. Most of the tree fruit produced is grown on the Freewater soils. A wide variety of vegetable crops, including onions, carrots, asparagus, lima beans, and miscellaneous small fruit and vine crops, are grown on Hermiston and Umapine soils that have been reclaimed. A substantial nursery business for both orchard trees and landscape trees and shrubs is also located in this region.

The predominant forms of irrigation are furrow and sprinkler; however, drip irrigation is gaining rapid acceptance in tree fruit production.

The primary management consideration for the soils of this area is proper irrigation water management. Erosion caused by irrigation water runoff is a hazard in sloping areas of Ellisforde soils. Overirrigation and subsequent leaching of nutrients is a problem on the somewhat excessively drained Freewater soils.

About 21,000 acres of the soils in the survey area have a seasonal high water table that is close enough to the surface to significantly restrict planting and harvesting of field crops. These soils are used almost exclusively as pastureland. Commonly, a water table exists in depressional areas where subirrigation from canals or overirrigation occurs. Drainage problems may be compounded by the application of water by inefficient irrigation methods. The wet Wanser and Adkins soils have a seasonal high water table in spring through fall.

Commonly associated with a water table is the accumulation of salts in the soil. Not only does the excess water interfere with the normal growth of many crops, excess salts, particularly sodium, adversely affect plant growth. Soils such as those of the Umapine and Pedigo series have both a seasonal water table and high sodium content.

Drainage can be improved in many areas by use of surface or subsurface systems. Surface systems include open drain ditches, impoundments, and land shaping to eliminate depressional areas. If outlets are not available, the excess water must be pumped. In order for soils that have both a water table and excessive amounts of salts to be reclaimed properly, it is necessary not only to lower the water table but to reduce the amount of toxic salts in the soils. Generally, excess salts can be removed from the soils by flushing them with irrigation water. The methods used, however, depend largely upon the amount and type of salts present.

There are several advantages to draining soils and removing excess salts. Not only does this procedure offer the opportunity to grow a wider variety of crops, but it generally results in greater yields. Also, drainage provides for better irrigation water management and accessibility to fields.

In general, gravity irrigation systems such as border, flood, corrugation, and furrow are adapted to nearly level soils such as those of the Wanser and Pedigo series.

The wide variety of crops that can be grown under irrigation requires that specialized fertilizer programs be developed. As with nonirrigated crops, the kinds and amounts of fertilizer should be based on soil tests, crop needs, and expected yields.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils generally are grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in table 5.

Rangeland and Woodland Understory Vegetation

Jacy Gibbs, range conservationist, Soil Conservation Service, prepared this section.

Rangeland occupies about 600,000 acres, or about 35 percent, of the survey area. The native vegetation produced on rangeland helps to conserve water and maintain stable watersheds, and it provides important scenic and recreational values. In addition, this area provides forage for livestock in all seasons as well as forage and cover for wildlife. Rangeland and grazeable woodland occur mainly in the southern part of the survey area, and together they make up the survey area's total grazing resource of about 850,000 acres.

Cow-calf operations are most common in the area and are operated as incorporated family ranch units. Cattle and sheep graze about 7 months during the year, generally from April through October. Fall grazing usually is supplemented by wheat stubble and other crop aftermath. There is some winter grazing on cover crops, crop residue, and rangeland in the northwestern part of the survey area.

The sandy soils in the Columbia Basin are mainly shrub-grasslands. The potential native vegetation on these soils consists of a shrub overstory of basin big sagebrush or antelope bitterbrush and an understory of needleandthread or bluebunch wheatgrass. Forbs are insignificant components of these plant communities.

On the Columbia Plateau, the rangeland is true grassland. Shrubs are insignificant in the potential native plant community; grasses, primarily bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass, are dominant. Forbs make up less than 15 percent of the potential native plant community.

The foothills of the Blue Mountains are both true grasslands, similar to those in the central part of the survey area, and shrub-grasslands. The potential native vegetation of the shrub-grasslands consists of an overstory of common snowberry, mallow ninebark, rose, or hawthorn and an understory of Idaho fescue.

The poor condition of the plant community in many parts of the survey area is a result of prolonged heavy grazing. This occurred mostly in the period extending from the 1880's to the 1920's, when large numbers of sheep, horses, and cattle were grazed. The preferred forage plants have decreased and have been replaced by less preferred plants. The density and vigor of preferred plants are less than those of the potential native plant community.

Natural plant communities that represent the productive potential within the survey area are common because areas are used only in alternate years by livestock as a result of the wheat-fallow method of farming that is used.

About 60 percent of the rangeland in the survey area is producing at half of its potential or less.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on grazing sites are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the grazing site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as grazing sites or are suited to use as grazing sites are listed. Explanation of the column headings in table 6 follows.

A *grazing site* is a distinctive kind of land that produces a characteristic natural plant community that differs from natural plant communities on other grazing sites in kind, amount, and proportion of forage plants. The relationship between soils and vegetation was established during this survey; thus, grazing sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of forage plants. Soil reaction, salt content, and a seasonal water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed land that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruit of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Grazing site management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Grazing site condition is determined by comparing the present plant community with the potential natural plant community on a particular grazing site. The more closely the existing community resembles the potential community, the better the grazing site condition. Grazing site condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in grazing site management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimal production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a grazing site condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Woodland Management and Productivity

James F. McClinton, forester, Soil Conservation Service, helped to prepare this section.

The survey area is one of the more important producers of timber in the northeastern part of Oregon. The best timber growing sites generally are in areas of soils that are derived from volcanic ash at intermediate elevations of the forested zone. The higher elevations generally are too cold and the lower elevations too dry to produce large quantities of timber in short rotations.

About 15 percent of the survey area is classified as commercial woodland, most of which is in the southern part of the area. About 59 percent of the commercial woodland is privately owned.

The town of Pendleton is recognized as the center of the forest products industry in Umatilla County. The

county has several large sawmills. Access to rail transportation and the Columbia River facilitates the export of finished lumber, logs, and wood chips.

Sawmill capacity exceeds the timber growth rate in the survey area, but intensive management practices such as thinning and fertilization potentially can increase productivity.

The primary conifer species are Douglas-fir, ponderosa pine, lodgepole pine, grand fir, and western larch. There are smaller amounts of Engelmann spruce, subalpine fir, and western juniper.

Recent wildfires have favored the establishment of lodgepole pine, which reproduces best under conditions of open sunlight and at the expense of species such as Douglas-fir and grand fir.

The Forest Service, the State Department of Forestry, and local fire districts provide fire protection service. The increasing population and recreational activities in the survey area make accidental fires a constant threat, especially during dry summers.

Dwarf mistletoe (*Arceuthobium spp.*) is the most destructive parasite of western larch, Douglas-fir, and ponderosa pine. Laminated root rot (*Phylinius weirii*) is a serious disease of Douglas-fir. Red ring rot (*Fomes pini*) is a serious disease of western larch, lodgepole pine, Douglas-fir, and ponderosa pine. Other diseases may present a serious threat in individual stands of trees.

The most serious insect problem is the western spruce budworm (*Choristoneura occidentalis*), which reduces growth dramatically by defoliating Douglas-fir and true firs. The larch casebearer (*Coleophora laricella*) causes defoliation of western larch. The mountain pine beetle (*Dendroctonus ponderosae*), pine engraver (*Ips pini*), and red turpentine beetle (*Dendroctonus pseudotsugae*) periodically kill large numbers of trees. The Douglas-fir tussock moth (*Hemerocampa pseudotsugata*) occasionally builds up to large populations and can kill Douglas-fir, grand fir, subalpine fir, and western larch.

The principal forest cover is the interior Douglas-fir type. Typically, stands are dominated by Douglas-fir mixed with small amounts of western larch, ponderosa pine, grand fir, and lodgepole pine. The grand fir and lodgepole pine types generally are at intermediate elevations with the interior Douglas-fir type. The interior ponderosa pine type is at the lower elevations, and the Engelmann spruce-subalpine fir type is at the higher elevations.

Woodland in the survey area provides forage for livestock and wildlife. Elk and deer use forage in recently harvested areas and in areas where the overstory is not dense. The amount of forage available under timber stands varies with the density of the overstory. The ponderosa pine type has the potential to produce high quality bunchgrass in the understory.

Soils vary in their ability to produce trees. Depth, fertility, texture, and the available water capacity influence tree growth. Elevation, aspect, soils, and climate determine the kinds of trees that can be expected to grow on any site.

The Blue Mountains can be divided into several contrasting areas based on soil climate. The moderately sloping and nearly level plateaus contain the deep, ashy Tolo soils and the moderately deep Klicker soils. The steep hillsides support deep, forested soils such as those of the Kahler and Umatilla series on northern exposures and shallow rangeland soils on southern exposures.

Lodgepole pine, western larch, grand fir, and Douglas-fir grow well on the Tolo soils. The indicator species for site index determination on the Tolo soils are western larch and Douglas-fir (*8, 9, 10*). Ponderosa pine is the indicator species for the Klicker soils (*14*). Douglas-fir is the indicator species for the Umatilla and Kahler soils. Subalpine fir is the indicator species for the Helter soils (*1*).

Many forest fringe areas occupied by Cowsly soils have been cleared and are now productive agricultural land. Ponderosa pine is the indicator species. The vegetation on these soils would revert to mixed conifer forest if left idle.

Woodland managers will find soil surveys useful as they seek ways to increase the productivity of their woodland.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown

down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability. *Productivity class* is the yield in cubic feet per acre per year calculated at the age of culmination of the mean annual increment for fully stocked natural stands.

Trees to plant are those that are suited to the soils and to commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

Within the survey area, easy access to the Columbia River and the Blue Mountains makes these areas the most likely ones to be developed for recreation. They provide many recreational opportunities including boating, swimming, picnicking, hunting, fishing, camping, and hiking.

The Columbia River forms the boundary between Oregon and Washington in the northwestern part of the survey area. Public land along the Columbia River offers a wide variety of recreational activities. Hat Rock State Park and facilities near McNary Dam are among the recreational areas that are available for use.

Soils likely to be developed along the Columbia River are in general soil map units 3 and 4, which are described in the section "General Soil Map Units." They are characterized by gently rolling terraces with areas of exposed bedrock.

In these units, the Quincy, Winchester, and Burbank soils are limited for recreational development by a high hazard of soil blowing. The Starbuck soils and Rock outcrop are limited by depth to bedrock and steepness of slope.

Hunting of birds, deer, and elk is a major recreational activity within the survey area.

The Blue Mountains offer year-round recreational activities, including a variety of winter sports. Public land available for these activities includes Battle Mountain State Park and Emmigrant Springs State Park.

Soils in general soil map units 19, 20, and 22 make up most of the Blue Mountains area. These units are characterized by nearly level plateaus dissected by steep canyons. They support a patchwork of woodland and grassland vegetation that provides excellent habitat for game animals and scenic beauty for sightseers and hikers. The many streams throughout these units offer a variety of possibilities for recreation.

In these units soils such as those of the Tolo and Klicker series are limited by dustiness and steepness of slope in some areas. The Anatone soils are limited by depth to rock and stones. The Gwin soils are limited by steepness of slope, depth to rock, and stones. The Umatilla and Kahler soils are on steep hillslopes of canyons and are limited for recreational development because of the steepness of slope.

Other areas of recreational importance are the two reservoirs in the survey area—Cold Springs and McKay. These reservoirs are near Hermiston and Pendleton, respectively. Besides providing recreational activities such as swimming, boating, and fishing, both reservoirs are included in National wildlife refuges and allow hunting during certain periods of the year. The Bridge

Creek Wildlife Management Area, near Ukiah, also provides hunting opportunities during the regular hunting season.

In addition to the recreational facilities already mentioned, there are several small camping and picnicking areas scattered throughout the survey area.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties generally are favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey; for example, interpretations for dwellings without basements and for local roads and streets in table 10 and interpretations for septic tank absorption fields in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

The survey area supports a wide variety of wildlife. The kinds and numbers of most wildlife species in the area are related to the kinds of soil. This relationship is influenced primarily by the kinds of plant communities present, topography, and land use.

There are five major categories of wildlife within the survey area: (1) Big game; (2) upland game birds; (3) waterfowl; (4) furbearers and nongame wildlife; and (5) fish. Their occurrence and distribution in many cases can be related to the general soil map units.

Deer, elk, and bear are the major big game species in the survey area. Their basic habitat requirements include food, water, cover, and freedom from harrassment. These requirements commonly are met in general soil map units 15 through 21, which are primarily rangeland and timberland.

Pheasants, quails, mourning doves, Hungarian and chukar partridges, ruffed grouse, and blue grouse are the major upland game birds in the survey area. The key habitat requirements for pheasants, quails, and mourning doves are cover for nesting, hiding, and obtaining protection from winter weather. This habitat type is in areas of irrigated and nonirrigated cropland, riparian zones, pastureland, brushy fence rows, woodlots, and brushy draws, which commonly are present in general soil map units 1, 2, and 4 through 14.

Hungarian and chukar partridges use a habitat type that is characterized by brushy draws, steep rocky slopes, and canyon rimrock. These species feed on seed, grass, and insects, and they generally can maintain themselves at high population levels when sound range management is applied to the land. General soil map units 12, 13, and 15 through 17 provide this habitat type.

Ruffed and blue grouse use a habitat type that is characterized by dense stands of timber, brushy draws, and open grassy slopes. Maintaining a wide variety of plant types appears to be important. Seed- and fruit-bearing plants should be protected during woodland operations. Also, riparian zones should be maintained.

General soil map units 19, 20, and 21 provide this kind of habitat.

Nesting, feeding, and resting areas are required for waterfowl. Nesting areas are the most critical requirement late in spring and early in summer. Marsh areas, irrigation canals, lakes, and slow moving streams provide habitat for waterfowl such as as mallards, Canada geese, teal, pintails, and wood ducks. During the winter, large bodies of water such as McKay and Cold Spring Reservoirs and the Columbia River provide ideal areas for resting and feeding. General soil map units 1 through 5 provide habitat suitable for waterfowl.

Furbearing and hunted nongame wildlife such as beaver, muskrat, otter, mink, coyote, raccoon, and bobcat have a wide variety of habitat needs, including brushy streams, wetlands, and various types of rangeland and forest land.

The survey area has some rather small but important populations of wildlife that need special consideration because of their limited numbers and special habitat requirements. Included in this group are eagles, falcons, hawks, herons, and owls. Among the most important values of nongame wildlife are the nonconsumptive uses, such as bird watching and photography, that these forms of wildlife provide. General map units 1, 2, 12, 13, and 15 through 21 provide habitat suitable for this type of wildlife.

Water areas within the survey area are valuable as harvesting, spawning, and rearing areas for migratory fish, resident trout, and warmwater game fish.

General soil map units 1 and 2 contain the Umatilla and Walla Walla Rivers and McKay and Birch Creeks. In addition, map units 19, 20, and 21 contain several streams that provide suitable fish habitat. Also, the Columbia River in the northwestern part of the survey area is used extensively by anadromous fish such as salmon and steelhead and by resident trout and warmwater game fish.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building Site Development, Sanitary Facilities, Construction Materials, and Water Management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps and soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the

indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills generally are limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly

impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel, or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to

the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the taxonomic unit descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a *probable* source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an *improbable* source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils generally is preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is

subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 to 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each taxonomic unit under "Taxonomic Units and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added; for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (*2*) and the Unified soil classification system (*3*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification; for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 14.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4. 76, 2. 00, 0. 420, and 0. 074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each taxonomic unit under "Taxonomic Units and Their Morphology."

Clay as a soil separate consists of mineral soil particles that are less than 0. 002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1. 6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of

less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0. 02 to 0. 69. The higher the value the more susceptible the soil is to sheet and rill erosion.

Erosion factor T is an estimate of the maximum average rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the amount of stable aggregates 0. 84 millimeters in size. These are represented idealistically by USDA textural classes. Soils containing rock fragments can occur in any group.

1. Sand, fine sand, and very fine sand. These soils are extremely erodible, and vegetation is difficult to establish on them. Crops can be grown on these if intensive measures to control erosion are used.

2. Loamy sand, loamy fine sand, and loamy very fine sand. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loam, coarse sandy loam, fine sandy loam, and very fine sandy loam. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clay, silty clay, clay loam, and silty clay loam that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loam and sandy clay that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loam. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loam that is less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A cemented pan is a cemented or indurated subsurface layer at a depth of 5 feet or less. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A *thin* pan is one that is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A *thick* pan is one that is more than 3 inches thick if continuously indurated or more than 18 inches thick if it is discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave

and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Table 17 gives estimates of various water features. The estimates are used in land use planning that involves engineering decisions.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sand or gravelly sand. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay that has high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflow from streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered to be flooding. Standing water in swamps and marshes or in closed depressional areas is considered to be ponding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable period of flooding are estimated. Frequency is expressed as *none, rare, occasional,* frequent. *None* means that flooding is not probable, *rare* that it is unlikely but is possible under unusual weather conditions (chance of flooding in any year is 0 to 5 percent), *occasional* that it occurs infrequently under normal weather conditions (chance of flooding in any year is 5 to 50 percent), and *frequent* that it occurs often under normal weather conditions (chance of flooding in any year is more than 50 percent).

Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that flooding is most likely to occur is expressed in months. November-May, for example, means that flooding can occur during the period November through May. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and level of flooding and the relation of each soil on the landscape to historic flood. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table K are the depth to the seasonal high water table; the kind of water table that is, *perched, artesian,* or *apparent*; and the months of the year that the water table usually is highest. A water table that is seasonally high for less than 1 month is not indicated in the table.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally below an impermeable layer. When this layer is

penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower water table by a dry zone.

The two numbers in the column "High water table" indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*26*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (*Xer*, meaning dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploxeroll (*Hapl*, meaning minimal horizonation, plus *xeroll*, the suborder of the Mollisols that have a xeric moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haploxerolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-silty, mixed, mesic Typic Haploxerolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Taxonomic Units and Their Morphology

In this section, each taxonomic unit recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each unit. A pedon, a small three-dimensional area of soil, that is typical of the unit in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*25*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*26*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the unit.

The map units of each taxonomic unit are described in the section "Detailed Soil Map Units."

Adkins Series

The Adkins series consists of deep, well drained soils on terraces and terrace scarps of the Columbia River. These soils formed in eolian sand and gravelly alluvium. Slopes are 0 to 25 percent.

Typical pedon of Adkins fine sandy loam, 0 to 5 percent slopes, in the SE1/4SE1/4NW1/4 of sec. 20, T. 4 N., R. 29 E.

Ap—0 to 4 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; weak very fine granular structure; soft, very friable, slightly

sticky and nonplastic; many very fine roots; many very fine irregular pores; neutral; abrupt smooth boundary.

Bw—4 to 12 inches; very dark grayish brown (10YR 3/2) fine sandy loam, pale brown (10YR 6/3) dry; weak very fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; many very fine tubular pores; neutral; gradual wavy boundary.

BC—12 to 35 inches; very dark grayish brown (10YR 3/2) fine sandy loam, pale brown (10YR 6/3) dry; massive; soft, very friable, slightly sticky and nonplastic; few very fine roots; many very fine tubular pores; mildly alkaline; abrupt smooth boundary.

BCk—35 to 60 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; massive; soft, very friable, slightly sticky and nonplastic; few very fine roots; many very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline.

The particle-size control section is less than 18 percent clay and more than 15 percent sand that is fine or coarser. In some pedons pebbles are at a depth of 40 to 60 inches. Depth to lime is 24 to 43 inches. Depth to basalt is 60 inches or more.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value 3 to 5 when moist and 4 to 6 when dry, and it has chroma of 2 to 4 when moist or dry. It is very fine sandy loam to fine sandy loam.

The BC horizon has value of 3 to 5 when moist and 5 to 7 when dry, and it has chroma of 2 to 4 when moist or dry. The upper part of the BC horizon is very fine sandy loam to fine sandy loam. The lower part, below a depth of 40 inches, is fine sandy loam, loamy sand, or sand and in some pedons is 0 to 15 percent cobbles and 35 to 65 percent pebbles.

Albee Series

The Albee series consists of moderately deep, well drained soils on ridges and plateaus of the Blue Mountains. These soils formed in loess and residuum. Slopes are 2 to 15 percent.

Typical pedon of an Albee silt loam in an area of Albee-Bocker-Anatone complex, 2 to 15 percent slopes, in the NE1/4NW1/4NW1/4 of sec. 35, T. 1 N., R. 35 E.

A—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular pores; 5 percent pebbles; neutral; clear smooth boundary.

Bw1—10 to 20 inches; dark brown (7.5YR 3/3) silt loam, brown (10YR 5/3) dry; moderate coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 5 percent pebbles; neutral; clear wavy boundary.

Bw2—20 to 28 inches; dark brown (7.5YR 3/4) silt loam, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 10 percent pebbles; neutral; abrupt smooth boundary.

2R—28 inches; basalt.

The particle-size control section is 18 to 27 percent clay and more than 15 percent sand that is fine or coarser. Depth to basalt ranges from 20 to 40 inches. The mollic epipedon is 10 to 19 inches thick. The profile has hue of 10YR or 7.5YR.

The A horizon has value of 2 or 3 when moist, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. It is loam, silt loam, or clay loam. It is mainly free of rock fragments in the upper part, but it has as much as 30 percent rock fragments in the lower part.

Anatone Series

The Anatone series consists of shallow, well drained soils on ridges and plateaus of the Blue Mountains. These soils formed in loess and residuum. Slopes are 2 to 35 percent.

Typical pedon of an Anatone very cobbly silt loam in an area of Klicker-Anatone-Bocker complex, 2 to 15 percent slopes, in the NW1/4NW1/4 of sec. 24, T. 5 S.,R. 30 E.

A—0 to 5 inches; dark reddish brown (5YR 3/2) very cobbly silt loam, dark brown (7.5YR 4/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 25 percent cobbles and 25 percent pebbles; slightly acid; clear smooth boundary.

Bw—5 to 12 inches; dark reddish brown (5YR 3/2) extremely cobbly loam, dark brown (7.5YR 4/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 60 percent cobbles and 20 percent pebbles; slightly acid; abrupt smooth boundary.

2R—12 inches; basalt.

The particle-size control section is silt loam, loam, silty clay loam, or clay loam and is 22 to 30 percent clay and 50 to 75 percent rock fragments consisting of gravel,

cobbles, and stones. The thickness of the solum and depth to basalt range from 10 to 20 inches. The mollic epipedon is 10 to 19 inches thick.

The A horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 3 to 5 when dry, and chroma of 2 or 3 when moist and 2 to 4 when dry.

The B horizon has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 3 to 5 when dry, and chroma of 2 or 3 when moist and 2 to 4 when dry.

Anderly Series

The Anderly series consists of moderately deep, well drained soils on hills. These soils formed in loess. Slopes are 1 to 35 percent.

Typical pedon of Anderly silt loam, 1 to 7 percent slopes, in the SE1/4SW1/4NE1/4 of sec. 4, T. 2 N., R. 32 E.

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; few pebbles; neutral; abrupt smooth boundary.

A2—6 to 13 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral; gradual smooth boundary.

Bw1—13 to 22 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak medium prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; few pebbles; moderately alkaline; clear smooth boundary.

Bw2—22 to 24 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 5 percent pebbles; moderately alkaline; clear smooth boundary.

2R—24 to 30 inches; fractured bedrock with silica and lime cementation between fractures over solid basalt.

The particle-size control section is 10 to 17 percent clay and less than 15 percent sand that is coarser than very fine sand. Thickness of the solum and depth to basalt range from 20 to 40 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 moist or dry.

Athena Series

The Athena series consist of deep, well drained soils on hills. These soils formed in loess. Slopes are 1 to 12 percent. Elevation is 1,200 to 2,300 feet. The mean annual precipitation is 15 to 20 inches, the mean annual temperature is 48 to 52 degrees F, and the frost-free period is 130 to 190 days.

Typical pedon of Athena silt loam, 1 to 7 percent slopes, in the NE1/4NW1/4SE1/4 of sec. 28, T. 4 N., R. 35 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine and very fine irregular pores; lower 1/4 inch is a firm platy dense plowpan; slightly acid; abrupt smooth boundary.

A1—8 to 15 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; neutral; clear wavy boundary.

A2—15 to 26 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak coarse prismatic structure parting to moderate fine subangular blocky; hard friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; neutral (pH 6.9); gradual wavy boundary.

Bw1—26 to 39 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; neutral; clear wavy boundary.

Bw2—39 to 46 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; weak medium and coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine roots; many very fine and fine pores; mildly alkaline; abrupt wavy boundary.

BCk1—46 to 53 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; weak medium and coarse subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few very fine roots; many very fine pores; few dark gray medium and coarse sand particles; slightly effervescent; segregated lime in filaments or threads; moderately alkaline; clear wavy boundary.

BCk2—53 to 65 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine pores; few coarse and very coarse sand particles; slightly effervescent;

segregated lime in filaments or threads; moderately alkaline.

The particle-size control section is 18 to 27 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 20 to 30 inches thick. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry.

The Bw horizon has value of 3 or 4 when moist and 4 to 6 when dry, and it has chroma of 2 to 4 when moist or dry.

The BC horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry, and chroma of 3 or 4 when moist or dry.

Bakeoven Series

The Bakeoven series consists of very shallow, well drained soils on ridges. These soils formed in loess and residuum. Slopes are 2 to 20 percent.

Typical pedon of a Bakeoven very cobbly loam in an area of Morrow-Bakeoven complex, 2 to 20 percent slopes, in the SW1/4NE1/4 of sec. 24, T. 1 S., R. 30 1/2 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) very cobbly loam, brown (10YR 5/3) dry; weak very thin platy structure parting to weak very fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 25 percent cobbles and 25 percent pebbles; neutral; abrupt wavy boundary.

BA—3 to 6 inches; dark brown (7.5YR 3/3) very gravelly loam, brown (7.5YR 5/3) dry; weak thin platy structure parting to weak very fine granular; hard, friable, sticky and slightly plastic; many very fine roots; many very fine tubular pores; 15 percent cobbles and 35 percent pebbles; neutral; abrupt wavy boundary.

Bw—6 to 8 inches; dark brown (7.5YR 3/3) very gravelly clay loam, brown (7.5YR 5/3) dry; moderate fine angular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; 10 percent cobbles and 40 percent pebbles; neutral; abrupt wavy boundary.

2R—8 inches; basalt.

The particle-size control section is 50 to 75 percent rock fragments. Thickness of the mollic epipedon and solum and depth to basalt range from 4 to 12 inches. The solum has hue of 10YR or 7.5YR.

The A horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when moist or 2 to 4 when dry.

The Bw horizon has value of 4 or 5 when dry, and it has chroma of 2 to 4 when moist or dry.

Bocker Series

The Bocker series consists of very shallow, well drained soils on hills and plateaus of the Blue Mountains. These soils formed in residuum mixed with loess. Slopes are 1 to 35 percent.

Typical pedon of a Bocker very cobbly silt loam in an area of Albee-Bocker-Anatone complex, 2 to 15 percent slopes, in the NE1/4NW1/4SE1/4 of sec. 19, T. 2 S., R. 34 E.

A—0 to 4 inches; dark brown (7.5YR 3/3) very cobbly silt loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 20 percent cobbles and 20 percent pebbles; slightly acid; clear smooth boundary.

Bw—4 to 7 inches; dark brown (7.5YR 3/3) very cobbly silt loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 30 percent cobbles and 30 percent pebbles; slightly acid; abrupt smooth boundary.

2R—7 inches; basalt.

The particle-size control section is 35 to 70 percent pebbles, cobbles, and stones. Thickness of the mollic epipedon and depth to basalt range from 4 to 10 inches. The solum has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or 2 to 4 when dry.

Bowlus Series

The Bowlus series consists of deep, well drained soils on hillslopes of the Blue Mountains. These soils formed in loess and colluvium. Slopes are 40 to 70 percent.

Typical pedon of a Bowlus silt loam in an area of Bowlus-Buckcreek association, 40 to 70 percent slopes, in the NE1/4SE1/4NW1/4 of sec. 1, T. 1 N., R. 33 E.

A1—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; strong fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots, common coarse roots; many very fine irregular pores; neutral; gradual wavy boundary.

A2—8 to 19 inches; black (10YR 2/1) silt loam, very dark grayish brown (10YR 3/2) dry; strong fine subangular blocky structure parting to strong fine and medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots, common coarse roots; common very fine tubular pores; neutral; gradual wavy boundary.

BA—19 to 42 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots, common coarse roots; common very fine tubular pores; neutral; gradual wavy boundary.

2Bw—42 to 60 inches; dark brown (10YR 3/3), very cobbly silty clay loam, yellowish brown (10YR 5/4) dry; moderate very fine and fine angular blocky structure; hard, friable, sticky and plastic; common very fine and fine roots, few medium and coarse roots; common very fine tubular pores; 20 percent cobbles and 30 percent pebbles; neutral.

The particle-size control section is 0 to 10 percent rock fragments, 25 to 34 percent clay, and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 20 to 30 inches thick. The depth to basalt is 60 inches or more.

The A horizon has chroma of 1 or 2 when dry.

The BA horizon has value of 2 or 3 when moist, and it has chroma of 2 or 3 when dry. It is a silt loam or silty clay loam.

The 2Bw horizon has hue of 10YR or 7.5YR and value of 2 to 4 when moist or dry. It is 0 to 30 percent gravel and 0 to 30 percent cobbles.

Bridgecreek Series

The Bridgecreek series consists of moderately deep, well drained soils on terraces and terrace scarps. These soils formed in loess and tuffaceous sediment. Slopes are 1 to 35 percent.

Typical pedon of a Bridgecreek silt loam in an area of Bocker-Bridgecreek complex, 1 to 15 percent slopes, in the SE1/4NW1/4 of sec. 12, T. 6 S., R. 30 E.

A1—0 to 4 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to moderate fine and medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine irregular pores; 5 percent pebbles; neutral; gradual wavy boundary.

A2—4 to 10 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; 5 percent pebbles; neutral; clear wavy boundary.

BA—10 to 16 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; strong fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common fine roots; many very fine tubular pores; 5 percent pebbles; neutral; clear wavy boundary.

Bw1—16 to 20 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; strong fine subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; many very fine tubular pores; 5 percent pebbles; neutral; gradual wavy boundary.

Bw2—20 to 26 inches; dark yellowish brown (10YR 3/4) silty clay loam; pale brown (10YR 6/3) dry; strong fine subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; many very fine tubular pores; 5 percent cobbles and 5 percent pebbles; neutral; abrupt wavy boundary.

2Bt—26 to 32 inches; dark brown (7.5YR 3/3) clay, dark brown (7.5YR 3/4) dry; moderate medium prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, sticky and plastic; few fine roots; common tubular pores; 5 percent cobbles and 5 percent pebbles; many thick clay films in pores and on faces of peds; neutral; abrupt wavy boundary.

2Cr—32 to 60 inches; semiconsolidated light yellowish brown (10YR 6/4) tuffaceous material; 30 percent pockets of strong brown (7.5YR 4/6) clay loam throughout.

The particle-size control section is 45 to 60 percent clay and 5 to 15 percent rock fragments. Depth to the paralithic contact ranges from 20 to 40 inches. The mollic epipedon is 15 to 19 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry. The B horizon has value of 3 or 4 when moist, and it has chroma of 3 or 4 when moist. It is 30 or 40 percent clay.

The 2Bt horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 3 or 4 when moist or dry. It has 45 to 60 percent clay. There is an increase in clay content of 15 percent or more (absolute) within a vertical distance of 1 inch at the upper boundary.

Buckcreek Series

The Buckcreek series consists of moderately deep, well drained soils on hillslopes of the Blue Mountains. These soils formed in loess and colluvium. Slopes are 45 to 70 percent.

Typical pedon of a Buckcreek silt loam in an area of Buckcreek-Gwin association, 45 to 70 percent slopes, in the SW1/4NE1/4SW1/4 of sec. 18, T. 2 S., R. 33 E.

A—0 to 11 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; strong very fine and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine irregular pores; 5 percent pebbles; neutral; clear wavy boundary.

BA—11 to 23 inches; black (10YR 2/1) cobbly silt loam, very dark grayish brown (10YR 3/2) dry; strong fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular pores; 15 percent cobbles and 10 percent pebbles; neutral; clear wavy boundary.

2Bw—23 to 36 inches; dark brown (10YR 3/3) very cobbly silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; common very fine and fine roots; few very fine tubular pores; 30 percent cobbles and 25 percent pebbles; neutral; abrupt wavy boundary.

3R—36 inches; basalt.

The particle-size control section is 35 to 60 percent rock fragments and 25 to 34 percent clay. Depth to basalt ranges from 20 to 40 inches. The mollic epipedon is 20 to 30 inches thick.

The A horizon has value of 3 or 4 when dry, and it has chroma of 1 or 2 when dry. In some pedons it is a silty clay loam in the lower part.

The BA horizon, where present, is silt loam or silty clay loam and has 10 to 35 percent rock fragments. It has value of 3 or 4 when dry, and it has chroma of 1 or 2 when dry.

The 2B horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry, and chroma of 2 or 3 when moist and 2 to 4 when dry. It is 20 to 30 percent pebbles and 25 to 40 percent cobbles.

Burbank Series

The Burbank series consists of deep, excessively drained soils of terraces of the Columbia River. These soils formed in gravelly alluvial deposits mantled by eolian sand. Slopes are 0 to 5 percent.

Typical pedon of a Burbank loamy fine sand, 0 to 5 percent slopes, in the SW1/4NW1/4SE1/4 of sec. 31, T. 5 N., R. 28 E.

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) loamy fine sand, brown (10YR 5/3) dry; weak medium platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine irregular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.

A2—3 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand, brown (10YR 5/3) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine irregular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.

C1—6 to 25 inches; very dark grayish brown (10YR 3/2) loamy fine sand, brown (10YR 5/3) dry; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine irregular pores; 10 percent pebbles; mildly alkaline; abrupt wavy boundary.

2C2—25 to 30 inches; dark brown (10YR 3/3) very gravelly loamy fine sand, light brownish gray (10YR 6/2) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine irregular pores; 50 percent pebbles that are weakly cemented with lime-silica coatings on lower side; slightly effervescent; mildly alkaline; clear wavy boundary.

2C3—30 to 60 inches; very dark gray (10YR 3/1) and dark yellowish brown (10YR 3/1) extremely gravelly sand, dark gray (10YR 4/1) and yellowish brown (10YR 5/4) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; many very fine irregular pores; 75 percent pebbles and cobbles; many rock fragments have lime-silica coatings on lower sides; mildly alkaline.

Depth to a very gravelly layer ranges from 16 to 26 inches. The profile is loamy fine sand and sand between depths of 10 and 40 inches. It averages 25 to 40 percent pebbles and 10 to 15 percent cobbles. Depth to basalt is 60 inches or more. The profile has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 1 to 3 when moist or dry.

Burke Series

The Burke series consists of moderately deep, well drained soils on terraces and terrace scarps. These soils formed in loess over cemented alluvium. Slopes are 1 to 30 percent.

Typical pedon of Burke silt loam, 1 to 7 percent slopes, is in NW1/4SE1/4NE1/4 of sec. 11, T. 3 N., R. 29 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) coarse silt loam, pale brown (10YR 6/3) dry; weak medium platy structure parting to weak fine subangular blocky; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine irregular pores; effervescent; mildly alkaline; clear smooth boundary.

Bw—8 to 18 inches; brown (10YR 4/3) coarse silt loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine and very fine roots; many very fine tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary.

BCk—18 to 26 inches; brown (10YR 4/3) silt loam, light gray (10YR 7/2) dry; massive; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; common very fine tubular pores; violently effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

2Ckqm—26 to 60 inches; indurated duripan; weakly cemented in the upper part and strongly cemented in the lower part.

The particle-size control section is silt loam or coarse silt loam. It is 10 to 15 percent clay and less than 15 percent sand that is coarser than very fine sand. The duripan is at a depth of 20 to 40 inches.

The A horizon has value of 4 or 5 when moist and 6 or 7 when dry, and it has chroma of 2 or 3 when moist or dry. It ranges from noneffervescent to effervescent.

The BCk horizon has value or 4 or 5 when moist or 6 or 7 when dry, and it has chroma of 2 to 3 when moist or dry. It is 0 to 15 percent gravel.

The 2C horizon is weakly cemented to strongly cemented with lime and silica. It is 5 to 30 percent rock fragments.

Cantala Series

The Cantala series consists of deep, well drained soils on hills. These soils formed in loess and old alluvium. Slopes are 1 to 35 percent.

Typical pedon of Cantala silt loam, 12 to 20 percent slopes, in the NE1/4SW1/4SW1/4 of sec. 10, T. 1 N., R. 31 E.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; neutral; clear wavy boundary.

A2—5 to 16 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral; clear wavy boundary.

Bw1—16 to 26 inches; dark brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral; gradual wavy boundary.

Bw2—26 to 45 inches; dark brown (10YR 4/3) silt loam, yellowish brown (10YR 6/4) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; common very fine tubular pores; mildly alkaline; abrupt wavy boundary.

2Ck—45 to 60 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; strongly effervescent; segregated seams of lime; strongly alkaline.

The particle-size control section is 18 to 25 percent clay and less than 15 percent sand that is coarser than very fine sand. The solum is 40 to 60 inches thick, and the depth to basalt is 60 inches or more. The mollic epipedon is 10 to 19 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The Bw horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 to 4 when moist or dry.

Stratified sandy or silty material is below a depth of 40 inches in some pedons.

Catherine Series

The Catherine series consists of deep, somewhat poorly drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent.

Typical pedon of a Catherine silt loam in an area of Catherine Variant-Catherine silt loams, 0 to 3 percent slopes, in the NE1/4SW1/4SE1/4 of sec. 4, T. 2 N., R. 33 E.

A1—0 to 3 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear smooth boundary.

A2—3 to 7 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; many fine distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; mildly alkaline; clear wavy boundary.

A3—7 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; many concretions 2 to 5 millimeters in diameter; mildly alkaline; clear wavy boundary.

A4—16 to 22 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; many fine distinct dark yellowish brown (10YR 4/6) mottles; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; common very fine tubular pores; neutral; clear wavy boundary.

AC—22 to 25 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; many concretions 2 to 5 millimeters in diameter; neutral; clear wavy boundary.

C1—25 to 40 inches; very dark grayish brown (2.5Y 3/2) silt loam, grayish brown (2.5Y 5/2) dry; many fine distinct dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; neutral; clear wavy boundary.

2C2—40 to 60 inches; very dark grayish brown (2.5Y 3/2) gravelly silt loam, grayish brown (2.5Y 5/2) dry; many fine district dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; 15 percent pebbles; neutral.

The particle-size control section is 22 to 34 percent clay and less than 15 percent sand that is coarser than very fine sand. The 2C horizon is at a depth of 40 to 60 inches. The soil has an aquic moisture regime. Depth to basalt is 60 inches or more.

The upper part of the the A horizon has value of 3 or 4 when dry, and it has chroma of 2 or less. The lower part of the A horizon and the AC horizon have value of 2 or 3 when moist and 4 or 5 when dry, and they have chroma of 2 or less.

The C horizon has hue of 10YR or 2.5Y, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 or less.

The 2C horizon ranges from silt loam to sand. It is 0 to 50 percent pebbles and 0 to 10 percent cobbles.

Catherine Variant

The Catherine Variant consists of deep, poorly drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent.

Typical pedon of a Catherine Variant silt loam in an area of Catherine Variant-Catherine silt loams, 0 to 3 percent slopes, in the NE1/4SW1/4SE1/4 of sec. 4, T. 2 N., R. 33 E.

A1—0 to 2 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine and fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; neutral; clear wavy boundary. clear wavy boundary.

A2—2 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common fine and medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; mildly alkaline; clear wavy boundary.

A3—7 to 12 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; common very fine tubular pores; neutral (pH 7.2); clear wavy boundary.

A4—12 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common fine and medium distinct dark yellowish brown (10YR 4/6) mottles; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; common very fine tubular pores; neutral; abrupt wavy boundary.

AC—18 to 25 inches; very dark grayish brown (10YR 3.2) silt loam, grayish brown (10YR 5/2) dry; many fine and medium distinct dark yellowish brown (10YR 4/6) mottles; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; neutral; abrupt smooth boundary.

2C—25 to 60 inches; dark brown (10YR 3/3) very gravelly silt loam, brown (10YR 5/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; 55 percent gravel and 5 percent cobbles; neutral.

The particle-size control section is 22 to 34 percent clay and 15 percent or more sand that is fine or coarser. The 2C is at a depth of 20 to 40 inches. The profile has an aquic moisture regime. Depth to basalt is 60 inches or more.

The upper part of the A horizon has value of 2 or 3 when moist and 3 to 5 when dry, and it has chroma of 1 or 2 when moist or dry. The lower part of the A horizon and the AC horizon have value of 2 or 3 when moist and 4 or 5 when dry, and they have chroma of 1 or 2 when moist or dry. Mottles are distinct or prominent.

The 2C horizon is silt loam or loam. It is 40 to 60 percent pebbles and 5 to 10 percent cobbles.

Condon Series

The Condon series consists of moderately deep, well drained soils on hills. These soils formed in loess. Slopes are 1 to 40 percent.

Typical pedon of Condon silt loam, 1 to 7 percent slopes, in the NE1/4SW1/4SE1/4 of sec. 4, T. 1 N., R. 30 E.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral; clear smooth boundary.

A2—2 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine

roots; many very fine tubular pores; neutral; clear smooth boundary.

Bw1—8 to 20 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral; gradual wavy boundary.

Bw2—20 to 30 inches; dark brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; weak medium and coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; 2 to 3 percent pebbles; mildly alkaline; abrupt wavy boundary.

2R—30 inches; basalt.

The particle-size control section is 18 to 27 percent clay and less than 15 percent sand that is coarser than very fine sand. Depth to basalt ranges from 20 to 40 inches. The mollic epipedon is 10 to 19 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 to 4 when moist or dry.

Cowsly Series

The Cowsly series consists of deep, moderately well drained soils on plateaus of the Blue Mountains. These soils formed in loess and residuum. Slopes are 2 to 20 percent.

Typical pedon of Cowsly silt loam, 2 to 12 percent slopes, in the SE1/4NW1/4NW1/4 of sec. 26, T. 4 N., R. 36 E.

O1—2 inches to 0; partially decomposed pine needles and twigs.

A1—0 to 6 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many very fine irregular pores; neutral; clear smooth boundary.

A2—6 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; many very fine tubular pores; neutral; clear wavy boundary.

Bw1—14 to 23 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; many very fine tubular pores; slightly acid; clear wavy boundary.

Bw2—23 to 29 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; common very fine pores; many fine distinct (7.5YR 3/4 and 4/4) mottles; slightly acid; abrupt wavy boundary.

E—29 to 34 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and nonplastic; common very fine and fine roots; common very fine tubular pores; many fine distinct (7.5YR 3/4 and 4/4) mottles; neutral; abrupt irregular boundary.

2Btb1—34 to 44 inches; dark brown (10YR 3/3) silty clay, brown (10YR 5/3) dry; strong fine angular blocky structure; very hard, firm, very sticky and very plastic; common very fine and fine roots; common very fine tubular pores; few fine distinct (10YR 4/6) mottles; common moderately thick clay films on faces of peds and in pores; neutral; gradual wavy boundary.

2Btb2—44 to 60 inches; dark brown (7.5YR 3/3) silty clay, brown (7.5YR 4/4) dry; moderate medium angular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; few very fine pores; common moderately thick clay films on faces of peds and in pores; 5 percent pebbles; neutral.

The particle-size control section is 40 to 60 percent clay. The mollic epipedon is about 10 to 30 inches thick, and the depth to the 2Bt horizon ranges from 12 to 40 inches. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 to 3 when moist or dry. The lower part of this horizon is silt loam or silty clay loam.

The Bw horizon, where present, is silt loam or silty clay loam. It has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry.

The E horizon has value of 4 or 5 when moist and 6 or 7 when dry, and it has chroma of 1 or 2 when moist or dry. A stone line is at the lower boundary in some pedons.

The 2B horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 2 to 4 when moist or dry. It is silty clay or clay and averages 40 to 60 percent clay.

Ellisforde Series

The Ellisforde series consists of deep, well drained soils on terraces and terrace scarps. These soils formed

in loess that has been deposited over lacustrine sediment. Slopes are 1 to 20 percent.

Typical pedon of Ellisforde silt loam, 1 to 7 percent slopes, in the SE1/4NW1/4SW1/4 of sec. 23, T. 6 N., R. 35 E.

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium platy structure parting to weak very fine granular; soft, very friable, slightly sticky and nonplastic; many very fine roots; many very fine irregular pores; mildly alkaline; clear smooth boundary.

A2—3 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; soft, friable, slightly sticky and nonplastic; many very fine roots; many very fine tubular pores; neutral; clear wavy boundary.

Bw—10 to 19 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, friable, slightly sticky and nonplastic; many very fine roots; many very fine tubular pores; mildly alkaline; clear wavy boundary.

BCk—19 to 28 inches; dark grayish brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine roots; many very fine tubular pores; strongly effervescent; segregated lime in seams and filaments; moderately alkaline; abrupt wavy boundary.

2Ck1—28 to 35 inches; dark grayish brown (2.5Y 4/2) silt loam, pale brown (10YR 6/3) dry; massive; very hard, firm, slightly sticky and nonplastic; few very fine roots; common very fine tubular pores; strongly effervescent; segregated lime in seams; moderately alkaline; clear wavy boundary.

2Ck2—35 to 47 inches; dark grayish brown (2.5Y 4/2) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, firm, slightly sticky and nonplastic; few very fine roots; common very fine tubular pores; violently effervescent; segregated lime in seams; strongly alkaline; clear wavy boundary.

2Ck3—47 to 60 inches; dark grayish brown (2.5Y 4/2) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, firm slightly sticky and nonplastic; few very fine roots; common very fine tubular pores; 2 to 5 percent pebbles 2 to 5 millimeters in diameter; violently effervescent; segregated lime in seams; strongly alkaline.

The particle-size control section is 10 to 17 percent clay and less than 15 percent sand that is coarser than very fine sand. The depth to the 2C horizon is 20 to 36 inches. The mollic epipedon is 7 to 15 inches thick. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 2 to 4 when moist and 4 to 6 when dry, and it has chroma of 2 or 3 when moist or dry.

The 2Ck horizon has hue of 10YR or 2.5YR, value of 4 or 5 when moist or 6 or 7 when dry, and chroma of 2 or 3 when moist or dry.

Entic Durochrepts

Entic Durochrepts are shallow or moderately deep, well drained soils on terrace scarps. These soils formed in loess over cemented alluvium. Slopes are 20 to 40 percent.

Reference pedon of Entic Durochrepts, 20 to 40 percent slopes, in the NE1/4SW1/4SE1/4 of sec. 12, T. 1 N., R. 32 E.

A—0 to 2 inches; dark brown (10YR 3/3) very gravelly loam, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 5 percent cobbles and 50 percent pebbles; slightly effervescent; moderately alkaline; clear wavy boundary.

Bk1—2 to 7 inches; dark brown (10YR 3/3) very gravelly clay loam, very pale brown (10YR 7/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many very fine roots; many very fine tubular pores; 5 percent cobbles and 50 percent pebbles; strongly effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

Bk2—7 to 11 inches; brown (10YR 4/3) very gravelly clay loam, very pale brown (10YR 7/4) dry; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine roots; many very fine tubular pores; 5 percent cobbles and 55 percent pebbles; strongly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

2Ckqm1—11 to 19 inches; extremely gravelly, weakly cemented duripan; rock fragments are lime-coated; abrupt wavy boundary.

2Ckqm2—19 to 60 inches; extremely gravelly, strongly cemented duripan.

The particle-size control section is 15 to 70 percent rock fragments. Depth to the duripan ranges from 10 to 40 inches. The soil has an ochric epipedon.

The A horizon is silt loam or loam and has 0 to 15 percent cobbles and 5 to 50 percent pebbles. It has

value of 3 or 4 when moist and 4 to 7 when dry, and it has chroma of 2 or 3 when moist or dry.

The Bk horizon is silt loam or clay loam. It has value of 3 or 4 when moist and 5 to 7 when dry, and it has chroma of 3 or 4 when moist or dry.

The 2Ckqm horizon is 50 to 90 percent rock fragments.

Esquatzel Series

The Esquatzel series consists of deep, well drained soils on flood plains. These soils formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Esquatzel silt loam, 0 to 3 percent slopes, in the NE1/4SE1/4SE1/4, sec. 18, T. 3 N., R. 28 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium roots; many very fine tubular pores; mildly alkaline; clear wavy boundary.

A1—9 to 18 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; many very fine tubular pores; moderately alkaline; abrupt wavy boundary.

A2—18 to 21 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine tubular pores; moderately alkaline; abrupt wavy boundary.

ABk—21 to 28 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; many very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

Bk1—28 to 42 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak coarse and very coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

Bk2—42 to 60 inches; very dark grayish brown (10YR 3/2) coarse silt loam to very fine sandy loam, brown (10YR 5/3) dry; weak very coarse and coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; slightly effervescent; disseminated lime; moderately alkaline.

The particle-size control section is less than 18 percent clay and is less than 15 percent sand that is coarser than very fine sand. Depth to free carbonates ranges from 12 to 40 inches. Depth to basalt is 60 inches or more.

The A horizon has a chroma of 2 or 3.

The B horizon has a value of 5 or 6 when dry, and it has chroma of 2 to 4. It has lenses of very fine sandy loam in the particle-size control section in some pedons. Below a depth of 40 inches the texture ranges from silt loam or stratified silt loam to fine sandy loam. Some pedons have few pebbles below a depth of 40 inches.

Freewater Series

The Freewater series consists of deep, somewhat excessively drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent.

Typical pedon of Freewater very cobbly loam, 0 to 3 percent slopes, in the NE1/4NW1/4NW1/4 of sec. 36, T. 6 N., R. 35 E.

A1—0 to 4 inches; very dark brown (10YR 2/2) very cobbly loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; 20 percent cobbles and 30 percent pebbles; many cobbles on surface; neutral; gradual wavy boundary.

A2—4 to 20 inches; very dark brown (10YR 2/2) very gravelly loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine tubular pores; 10 percent cobbles and 45 percent pebbles; neutral; clear wavy boundary.

2C1—20 to 41 inches; very dark brown (10YR 2/2) extremely gravelly sand, dark grayish brown (10YR 4/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; common medium irregular pores; 15 percent cobbles and 70 percent pebbles; neutral; abrupt wavy boundary.

2C2—41 to 60 inches; dark brown (7.5YR 3/2) extremely gravelly sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; common medium irregular pores; 25 percent cobbles and 60 percent pebbles; neutral.

The particle-size control section is 45 to 75 percent rock fragments. The mollic epipedon is 15 to 19 inches thick. Depth to the 2C horizon is 15 to 24 inches. Depth to basalt is 60 inches or more.

The upper part of the The A horizon has chroma of 2 or 3 when moist. It is gravelly silt loam or very cobbly loam. The lower part has chroma of 2 or 3 when moist.

The 2C horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2

or 3 when dry. It is extremely gravelly or extremely cobbly sand or loamy sand and averages 65 to 85 percent rock fragments. Horizons that are extremely gravelly or extremely cobbly sandy loam 5 inches or less in thickness are present in the 2C horizon in some pedons.

In some pedons there is an AC horizon of extremely gravelly sandy loam.

Gurdane Series

The Gurdane series consists of moderately deep, well drained soils on hills of the Blue Mountains. These soils formed in loess and residuum. Slopes are 0 to 45 percent.

Typical pedon of Gurdane silty clay loam, 7 to 25 percent slopes, in the NE1/4NW1/4NW1/4 of sec. 23, T. 3 S., R. 30 E.

A1—0 to 3 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine irregular pores; 5 percent pebbles; slightly acid; clear wavy boundary.

A2—3 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine irregular pores; 5 percent pebbles; neutral; clear wavy boundary.

Bw—9 to 20 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong medium subangular blocky structure; slightly hard, friable, sticky and plastic; many fine roots; many fine tubular pores; 10 percent pebbles; neutral; abrupt smooth boundary.

2Bt—20 to 30 inches; dark brown (10YR 3/3) very cobbly clay, brown (10YR 4/3) dry; moderate fine and medium angular blocky structure; hard, firm, very sticky and very plastic; many fine roots; common fine tubular pores; 30 percent cobbles and 20 percent pebbles; many moderately thick clay films in pores and on faces of peds; neutral; abrupt wavy boundary.

2R—30 inches; basalt.

The particle-size control section is 40 to 50 percent clay and 35 to 70 percent rock fragments. The mollic epipedon is 20 to 30 inches thick. Depth to basalt ranges from 20 to 40 inches.

The A horizon has value of 2 or 3 when moist and 3 to 5 when dry, and it has chroma of 1 or 2 when moist or dry. The A horizon is 0 to 10 percent pebbles.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry. It is 0 to 5 percent cobbles and 5 to 10 percent pebbles.

The 2B horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 2 to 4 when moist or dry. It is 20 to 50 percent cobbles and 10 to 30 percent pebbles. It is very cobbly clay or extremely cobbly clay.

Gwin Series

The Gwin series consists of shallow, well drained soils on hills of the Blue Mountains. These soils formed in colluvium, residuum, and loess. Slopes are 30 to 70 percent.

Typical pedon of a Gwin very cobbly silt loam in an area of Gwin-Rock outcrop complex, 40 to 70 percent slopes, in the NE1/4SE1/4NW1/4 of sec. 6, T. 1 N., R. 34 E.

A—0 to 7 inches, very dark brown (10YR 2/2) very cobbly silt loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; 5 percent stones, 25 percent cobbles, and 30 percent pebbles; neutral; clear wavy boundary.

Bt—7 to 13 inches; very dark brown (10YR 2/2) very cobbly silty clay loam, brown (7.5YR 4/2) dry; moderate medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; many fine tubular pores; 45 percent cobbles and 15 percent pebbles; neutral; clear wavy boundary.

2R—13 inches; fractured basalt.

The particle-size control section is 50 to 80 percent rock fragments. The thickness of the solum and depth to basalt range from 10 to 20 inches.

The A horizon has chroma of 1 or 2 when moist or dry.

The B horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist, and chroma of 2 or 3 when moist or dry. It is silt loam or silty clay loam.

Gwinly Series

The Gwinly series consists of shallow, well drained soils on hills of the Blue Mountains. These soils formed in colluvium, residuum, and loess. Slopes are 7 to 40 percent.

Typical pedon of Gwinly very cobbly silt loam, 7 to 40 percent slopes, in the SW1/4SW1/4SE1/4 of sec. 28, T. 1 N., R. 33 E.

A—0 to 2 inches; very dark brown (10YR 2/2) very cobbly silt loam, dark grayish brown (10YR 4/2) dry; strong medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular pores;

few stones, 25 percent cobbles, and 20 percent pebbles; neutral; clear smooth boundary.

Bw—2 to 7 inches; very dark brown (10YR 2/2) very cobbly silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; common very fine tubular pores; few stones, 25 percent cobbles, and 20 percent pebbles; neutral; clear wavy boundary.

Bt—7 to 15 inches; dark brown (10YR 3/3) very cobbly clay, dark brown (7.5YR 4/3) dry; strong medium angular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; 35 percent cobbles and 25 percent pebbles; common thin clay films in pores and on faces of peds; neutral; abrupt wavy boundary.

R—15 inches; basalt.

The particle-size control section is 40 to 50 percent clay and 40 to 85 percent rock fragments. The thickness of the solum and depth to basalt range from 10 to 20 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist and 2 or 3 when dry.

The Bt horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 to 4 when moist or dry.

Hankins Series

The Hankins series consists of deep, well drained soils on foot slopes. These soils formed in loess over tuffaceous sediment. Slopes are 2 to 35 percent.

Typical pedon of Hankins silt loam, 2 to 15 percent slopes, in the NW1/4SW1/4 of sec. 10, T. 5 S., R. 32 E.

O—1 inch to 0; partially decomposed pine needles and twigs.

A—0 to 9 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; many fine and very fine roots; many fine irregular pores; 5 percent pebbles; slightly acid; clear wavy boundary.

Bw1—9 to 18 inches; dark brown (7.5YR 3/2) silty clay loam, brown (10YR 5/3) dry; strong medium and fine angular blocky structure; hard, friable, sticky and plastic; many fine and very fine roots; many fine irregular pores; 5 percent pebbles; slightly acid; clear wavy boundary.

Bw2—18 to 20 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; strong medium and fine angular blocky structure; hard, friable, sticky and plastic; common very fine roots; many fine tubular pores; 5 percent pebbles; neutral; abrupt wavy boundary.

2Bt—20 to 26 inches; very dark grayish brown (10YR 3/2) clay, dark brown (10YR 4/3) dry; moderate coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, firm, very sticky and very plastic; few very fine roots; common fine tubular pores; many moderately thick clay films in pores and on faces of peds; 5 percent pebbles; neutral; abrupt wavy boundary.

2BC—26 to 44 inches; dark brown (7.5YR 3/4) clay loam, yellowish brown (10YR 5/4) dry; massive; hard, firm, sticky and plastic; few very fine roots; few fine tubular pores; 5 percent pebbles; slightly effervescent; segregated lime in seams; mildly alkaline; gradual wavy boundary.

2Cr—44 to 60 inches; variegated partially weathered tuffaceous material with 20 percent water-rounded cobbles and pebbles.

The particle-size control section is 45 to 60 percent clay and 0 to 10 percent rock fragments. Depth to the paralithic contact ranges from 40 to 60 inches. The mollic epipedon is 20 to 30 inches thick.

The A horizon has value of 2 or 3 when moist and 3 to 5 when dry, and it has chroma of 1 to 3 when moist or dry.

The Bw horizon, where present, has hue of 7.5YR or 10YR, and it has chroma of 2 or 3 when moist or dry. It is 30 to 35 percent clay.

The 2Bt horizon has hue of 10YR or 7.5YR, value of 2 to 4 when moist and 4 to 7 when dry, and chroma of 2 to 4 when moist or dry.

In some pedons there is a loam or clay loam layer immediately above the paralithic contact.

Helter Series

The Helter series consists of deep, well drained soils on plateaus and hills of the Blue Mountains. These soils formed in volcanic ash over a buried soil. Slopes are 2 to 35 percent.

Typical pedon of Helter silt loam, 2 to 15 percent slopes, in the NE1/4NE1/4 of sec. 31, T. 4 N., R. 38 E.

O—1 inch to 0; litter composed of needles, leaves, wood fragments, and moss; matted by mycelia and fine roots.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine, fine, medium, and coarse roots; many very fine pores; slightly acid; abrupt wavy boundary.

Bw1—6 to 15 inches; dark yellowish brown (10YR 4/4) silt loam, very pale brown (10YR 7/4) dry; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine, fine,

medium, and coarse roots; many very fine pores; slightly acid; clear wavy boundary.

Bw2—15 to 33 inches; yellowish brown (10YR 5/6) silt loam, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; soft, friable, nonsticky and nonplastic; common very fine, fine, medium, and coarse roots; many very fine pores; slightly acid; abrupt irregular boundary.

2Bwb1—33 to 40 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; few medium and many fine and very fine tubular pores; medium acid; clear wavy boundary.

2Bwb2—40 to 48 inches; dark yellowish brown (10YR 4/4) gravelly heavy silt loam, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; common very fine tubular pores; 15 percent pebbles; medium acid; gradual smooth boundary.

2BCb—48 to 60 inches; dark brown (10YR 4/3) (crushed, variegated and mottled) gravelly heavy silt loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; hard, firm, slightly sticky and plastic; many very fine tubular pores; 15 percent pebbles; medium acid.

The ash mantle ranges from 20 to 40 inches in thickness. It has moist bulk density of less than 0.85 gram per cubic centimeter. Depth to basalt is 60 inches or more.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry.

The B horizon has hue of 10YR to 5YR, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 3 to 6 when moist or dry. The 2Bb horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 moist. It is silt loam, loam, or silty clay loam and is 0 to 30 percent rock fragments. The lower part commonly is gravelly or cobbly.

Hermiston Series

The Hermiston series consists of deep, well drained soils on flood plains. These soils formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Hermiston silt loam, 0 to 3 percent slopes, in the SE1/4 of sec. 21, T. 2 N., R. 33 E.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular pores and many very fine interstitial pores; black plowpan 1/4 inch thick at bottom of horizon; mildly alkaline; abrupt smooth boundary.

A1—10 to 16 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; mildly alkaline; clear irregular boundary.

A2—16 to 24 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine and few fine tubular pores; moderately alkaline; gradual wavy boundary.

Bk1—24 to 42 inches; dark brown (10YR 3/3) silt loam, light brownish gray (10YR 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; few firm calcareous nodules 1/8 to 1/2 inch in diameter; strongly effervescent; disseminated and segregated mycelial lime; moderately alkaline; clear wavy boundary.

Bk2—42 to 60 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine and few fine tubular pores; weakly effervescent; lime that is mainly disseminated; moderately alkaline.

The particle-size control section is 10 to 17 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 20 to 30 inches thick. The profile ranges from violently effervescent to noneffervescent and from neutral to moderately alkaline. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 to 3 when moist or dry.

The B horizon has value of 3 to 6 when moist and 5 to 7 when dry, and it has chroma of 2 to 3 when moist or dry.

Kahler Series

The Kahler series consists of deep, well drained soils on plateaus and hills of the Blue Mountains. These soils formed in loess and colluvium. Slopes are 2 to 70 percent slopes.

Typical pedon of Kahler silt loam in an area of Umatilla-Kahler association, 15 to 35 percent slopes, in the SW1/4SW1/4 of sec. 11, T. 2 S., R. 33 E.

O—1 inch to 0; pine needles and twigs.

A1—0 to 6 inches; very dark brown (10YR 2/2) silt loam, dark brown (10YR 4/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many fine irregular pores; 5 percent pebbles; slightly acid; clear wavy boundary.

A2—6 to 20 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 4/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many fine tubular pores; 5 percent pebbles; slightly acid; gradual wavy boundary.

Bw1—20 to 37 inches; dark brown (7.5YR 3/2) silty clay loam, dark brown (7.5YR 4/4) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, medium, and coarse roots; many fine tubular pores; 5 percent pebbles; medium acid; clear wavy boundary.

2Bw2—37 to 60 inches; dark brown (7.5YR 3/3) cobbly silty clay loam, brown (7.5YR 4/4) dry; moderate medium and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; many fine tubular pores; 15 percent cobbles and 15 percent pebbles; slightly acid.

The particle-size control section is 18 to 30 percent clay and 15 percent or more sand that is fine or coarser. Depth to basalt is 60 inches or more. Some areas have weathered granite bedrock at a depth of 40 to 60 inches. The mollic epipedon is 20 to 30 inches thick. The profile has hue of 10YR or 7.5YR.

The A horizon has value of 2 or 3 when moist and 3 to 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is silt loam or gravelly loam.

The B horizon has value of 3 or 4 when moist and 4 to 6 when dry, and it has chroma of 2 to 4 when moist or dry. It is silt loam or gravelly clay loam.

The 2B horizon has value of 4 or 5 when dry, and it has chroma of 2 to 4 when moist or dry. It is loam or silty clay loam and is 0 to 20 percent cobbles and 10 to 35 percent pebbles.

Kilmerque Series

The Kilmerque series consists of moderately deep, well drained soils on plateaus and hills of the Blue Mountains. These soils formed in loess and residuum. Slopes are 3 to 35 percent.

Typical pedon of a Kilmerque loam in an area of Tolo-Kilmerque association, 3 to 15 percent slopes, in the SW1/4NE1/4SE1/4 of sec. 20, T. 3 S., R. 31 E.

O1—1 inch to 0; partially decomposed pine needles and twigs.

A—0 to 4 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; strong fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine, fine and medium roots; many very fine pores; medium acid; clear wavy boundary.

Bw—4 to 12 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine, fine, medium, and coarse roots; common very fine pores; slightly acid; diffuse broken boundary.

BC—12 to 32 inches; dark brown (10YR 3/3) cobbly sandy loam, light olive brown (2.5Y 5/4) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common roots very fine, fine, medium, and coarse roots; common very fine pores; 20 percent cobbles and 10 percent pebbles; neutral (pH 6.6); diffuse broken boundary.

Cr—32 to 40 inches; partially decomposed granodiorite.

The particle-size control section is less than 18 percent clay and more than 15 percent sand that is fine or coarser. The mollic epipedon is 10 to 19 inches thick. Depth to weathered granodiorite is 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 3 to 5 when dry, and has chroma of 2 or 3 when moist or dry.

The B horizon has hue of 10YR or 2.5YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 3 to 6 when moist or dry. It is a loam or sandy loam.

Kimberly Series

The Kimberly series consists of deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent.

Typical pedon of Kimberly fine sandy loam, 0 to 3 percent slopes, in the SE1/4SW1/4NW1/4 of sec. 31, T. 4 N., R. 30 E.

A—0 to 10 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

BC1—10 to 14 inches; dark brown (10YR 3/3) fine sandy loam, pale brown (10YR 6/3) dry; massive; slightly hard, firm, nonsticky and nonplastic; few fine roots; common very fine tubular pores; moderately alkaline; clear smooth boundary.

BC2—14 to 30 inches; dark brown (10YR 3/3) very fine sandy loam, brown (10YR 6/3) dry; weak coarse prismatic structure; loose, friable, nonsticky and nonplastic; few fine roots; common very fine tubular pores; moderately alkaline; gradual wavy boundary.

BCk1—30 to 38 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores; slightly effervescent;

disseminated lime; moderately alkaline; gradual wavy boundary.

BCk2—38 to 60 inches; dark brown (10YR 4/3) very fine sandy loam, pale brown (10YR 6/3) dry; weak coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline.

The particle-size control section is less than 18 percent clay and more than 15 percent sand that is fine or coarser. The mollic epipedon is 10 to 19 inches thick. Some pedons do not have secondary carbonates or have pebbles at a depth of 40 to 60 inches. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is fine sandy loam or silt loam.

The BC horizon has value of 3 or 4 when moist and 5 or 6 when dry, chroma of 2 or 3 moist or dry. The texture below a depth of 40 inches commonly is highly stratified very fine sandy loam to sand.

Klicker Series

The Klicker series consists of moderately deep, well drained soils on plateaus and hills of the Blue Mountains. These soils formed in loess and residuum. Slopes are 2 to 40 percent.

Typical pedon of Klicker silt loam, 2 to 20 percent slopes, in the NE1/4SE1/4NE1/4 of sec. 2, T. 5 S., R. 30 E.

O—1 inch to 0; moss, pine needles, and twigs.

A1—0 to 2 inches; dark reddish brown (5YR 3/2) silt loam, dark brown (7.5YR 4/3) dry; moderate fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine irregular pores; 5 percent cobbles and 5 percent pebbles; neutral; clear smooth boundary.

A2—2 to 7 inches; dark reddish brown (5YR 3/2) silt loam, dark brown (7.5YR 4/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine to coarse roots; common very fine tubular pores; 5 percent cobbles and 10 percent pebbles; neutral; gradual wavy boundary.

Bt—7 to 21 inches; dark reddish brown (5YR 3/3) very cobbly silty clay loam, dark brown (7.5YR 4/4) dry; strong fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many very fine to coarse roots; common very fine tubular pores; common thin clay films in pores and on faces of peds; 30 percent cobbles and 25 percent pebbles; neutral; clear wavy boundary.

R—21 inches; basalt.

The particle-size control section is 25 to 34 percent clay and 35 to 60 percent rock fragments. The thickness of the solum and depth to the basalt range from 20 to 40 inches. Hue ranges from 5YR to 10YR.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is silt loam or very stony silt loam.

The B horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 to 4 when moist or dry. It is dominantly silty clay loam, but the texture ranges from heavy silt loam to silty clay loam.

Koehler Series

The Koehler series consists of moderately deep, somewhat excessively drained soils on terraces of the Columbia River. These soils formed in eolian sand deposited over cemented alluvium. Slopes are 0 to 5 percent.

Typical pedon of Koehler loamy fine sand, 0 to 5 percent slopes, in the SE1/4NW1/4SW1/4 of sec. 16, T. 4 N., R. 28 E.

A—0 to 11 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; single grain; loose, nonsticky and nonplastic; many very fine roots; few very fine irregular pores; neutral; abrupt wavy boundary.

BCk—11 to 24 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

2Ckqm—24 to 60 inches; very dark grayish brown (10YR 3/2) indurated duripan, grayish brown (10YR 5/2) dry; strongly to weakly cemented.

The particle-size control section is loamy sand, loamy fine sand, or fine sand. The duripan is at a depth of 20 to 40 inches.

The A horizon has value of 3 or 5 when moist and 5 to 7 when dry, and it has chroma of 2 or 3 when moist or dry.

The BC horizon has value of 3 to 5 when moist and 5 to 8 when dry, and it has chroma of 2 or 3 when moist or dry. It is loamy sand, loamy fine sand, or fine sand. Thin lenses of sandy loam are above the duripan in some pedons.

Lickskillet Series

The Lickskillet series consists of shallow, well drained soils on hills. These soils formed in colluvium and loess. Slopes are 7 to 70 percent.

Typical pedon of a Lickskillet very stony loam in an area of Lickskillet-Rock outcrop complex, 40 to 70

percent slopes, in the NE1/4NE1/4SW1/4 of sec. 23, T. 1 S., R. 31 E.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) very stony loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; 3 percent stones, 20 percent cobbles, and 20 percent pebbles; neutral; gradual wavy boundary.

Bw—6 to 18 inches; dark brown (10YR 3/3) very gravelly loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common to many very fine roots; common very fine tubular pores; 5 percent cobbles and 35 percent pebbles; mildly alkaline; abrupt wavy boundary.

R—18 inches; basalt.

The particle-size control section is 18 percent clay or more and 35 to 85 percent rock fragments. Thickness of the solum and depth to basalt range from 12 to 20 inches. The solum has hue of 10YR or 7.5YR.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. The lower part of some of the deeper pedons have value and chroma of 3 or 4 when moist. It is heavy loam or clay loam.

McKay Series

The McKay series consists of deep, well drained soils on piedmonts of the Blue Mountains. These soils formed in loess and old alluvium. Slopes are 0 to 25 percent.

Typical pedon of McKay silt loam, 0 to 7 percent slopes, in the SE1/4SE1/4SW1/4 of sec. 32, T. 2 N., R. 33 E.

Ap1—0 to 3 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine platy structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine tubular pores; medium acid; clear wavy boundary.

Ap2—3 to 11 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine tubular pores; medium acid; clear wavy boundary.

E—11 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium and coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; few very fine tubular pores; mildly alkaline; abrupt wavy boundary.

Bt—14 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; many black (10YR 2/1) organic stains on peds; strong medium and coarse columnar structure; very hard, very firm, sticky and slightly plastic; many moderately thick clay films in pores and on faces of peds; few very fine and fine roots; few very fine tubular pores; moderately alkaline; clear wavy boundary.

Btk—20 to 25 inches; dark yellowish brown (10YR 3/4) silty clay loam, yellowish brown (10YR 5/4) dry; few black (10YR 2/1) organic stains on peds; moderate fine and medium prismatic structure; very hard, firm, sticky and slightly plastic; common thin clay films on faces of peds; few very fine roots; few very fine tubular pores; slightly effervescent; disseminated lime; strongly alkaline; clear wavy boundary.

2Bk1—25 to 39 inches; brown (7.5YR 4/4) gravelly silt loam, yellowish brown (10YR 5/4) dry; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine tubular pores; 15 percent pebbles; strongly effervescent; segregated lime in seams and filaments; strongly alkaline; clear wavy boundary.

2Bk2—39 to 47 inches; dark brown (7.5YR 4/3) gravelly silty clay loam, brown (7.5YR 5/3) dry; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, sticky and slightly plastic; 5 percent cobbles and 10 percent pebbles; violently effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

2Ck—47 to 60 inches; pink (7.5YR 8/4) gravelly loam, white (10YR 8/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; 5 percent cobbles and 20 percent pebbles; violently effervescent; disseminated lime; moderately alkaline.

The particle-size control section is 27 to 34 percent clay and less than 15 percent sand that is coarser than very fine sand. Depth to basalt is 60 inches or more.

The Ap horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry.

The E horizon has chroma of 2 or 3 when moist or dry.

The upper part of the Bt horizon has value of 4 or 5 when dry, and it has chroma of 2 to 4 when moist or dry. It is mildly alkaline to strongly alkaline. The lower part of the Bt horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. It is strongly alkaline or very strongly alkaline.

The 2Bk horizon has hue of 10YR or 7.5YR, value of 5 or 6 when dry, and chroma of 3 or 4 when moist or dry.

It is heavy silt loam, clay loam, or silty clay loam that is 25 to 35 percent clay, 0 to 5 percent cobbles, and 5 to 20 percent pebbles.

The 2Ck horizon ranges from loam to silty clay loam. It is 25 to 35 percent clay and 20 to 50 percent rock fragments. It has hue of 10YR or 7.5YR, value of 5 to 8 when moist or dry, and chroma of 2 to 4 when moist or dry. It is moderately alkaline or strongly alkaline.

Mikkalo Series

The Mikkalo series consists of moderately deep, well drained soils on hills. These soils formed in loess. Slopes are 2 to 40 percent.

Typical pedon of Mikkalo silt loam, 12 to 20 percent slopes, in the NE1/4NE1/4SW1/4 of sec. 36, T. 3 N., R. 30 E.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine roots; many very fine tubular pores; 2 percent pebbles; neutral; clear smooth boundary.

A2—2 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine roots; many very fine tubular pores; 2 percent pebbles; neutral; clear smooth boundary.

Bw—7 to 15 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; many very fine tubular pores; 2 percent pebbles; neutral; clear wavy boundary.

BCk—15 to 22 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; many very fine tubular pores; 5 percent pebbles; slightly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

2R—22 inches; basalt.

The particle-size control section is 8 to 12 percent clay and less than 15 percent sand that is coarser than very fine sand. The solum is 20 to 30 inches thick. Depth to basalt ranges from 20 to 40 inches. The mollic epipedon is 7 to 15 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry.

The BC horizon has value of 4 to 6 when moist and 6 or 7 when dry, and it has chroma of 2 or 3 when moist or dry.

Mondovi Series

The Mondovi series consists of deep, well drained soils on flood plains. These soils formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Mondovi silt loam, 0 to 3 percent slopes, in the SW1/4NW1/4SE1/4 of sec. 32, T. 2 S., R. 30 E.

A1—0 to 12 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; mildly alkaline; gradual wavy boundary.

A2—12 to 36 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine and fine tubular pores; mildly alkaline; gradual wavy boundary.

Bw—36 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine tubular pores; mildly alkaline.

The particle-size control section is less than 18 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 60 inches thick or more. Depth to basalt is 60 inches or more.

The A horizon has chroma of 1 or 2 when moist or dry.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry.

Morrow Series

The Morrow series consists of moderately deep, well drained soils on hills. These soils formed in loess, residuum, and alluvium. Slopes are 1 to 40 percent.

Typical pedon of Morrow silt loam, 1 to 7 percent slopes, in the NW1/4NE1/4 of sec. 15, T. 1 S., R. 31 E.

A—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly

plastic; many very fine roots; many very fine irregular pores; neutral; clear wavy boundary.

2Bt—10 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine tubular pores; few thin clay films in pores and on faces of peds; mildly alkaline; clear wavy boundary.

BC—15 to 20 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; mildly alkaline; clear wavy boundary.

2BCk—20 to 27 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; 5 percent pebbles; slightly effervescent; disseminated lime and lime segregated in seams; moderately alkaline; abrupt wavy boundary.

3R—27 to 35 inches; fractured basalt with pockets of dark brown (7.5YR 4/4) material between cracks; fragments are lime coated.

The particle-size control section is 27 to 34 percent clay and less than 15 percent sand that is coarser than very fine sand. Thickness of the solum ranges between 15 to 30 inches, and depth to basalt ranges from 20 to 40 inches. The mollic epipedon is 10 to 19 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry.

The Bt horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is 27 to 34 percent clay.

The 2BCk horizon has value of 4 or 5 when moist and 6 or 7 when dry, and it has chroma of 2 or 3 when moist or dry.

Nansene Series

The Nansene series consists of deep, well drained soils on hillslopes. These soils formed in loess. Slopes are 35 to 70 percent.

Typical pedon of Nansene silt loam, 35 to 70 percent slopes, in the NW1/4NE1/4NE1/4 of sec. 11, T. 5 N., R. 35 E.

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many fine roots; many very fine irregular pores; neutral; clear wavy boundary.

A2—4 to 12 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; moderate medium and coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many fine roots; many very fine irregular pores; neutral; clear wavy boundary.

A3—12 to 20 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; weak medium and coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common fine roots; many very fine tubular pores; neutral; clear wavy boundary.

Bw—20 to 35 inches; dark brown (10YR 3/3) coarse silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure parting to weak coarse subangular blocky; soft, very friable, slightly sticky and nonplastic; common fine roots; many very fine tubular pores; neutral; gradual wavy boundary.

C—35 to 60 inches; dark brown (10YR 3/3) coarse silt loam, pale brown (10YR 6/3) dry; massive; soft, very friable, slightly sticky and nonplastic; few fine roots; common very fine tubular pores; mildly alkaline.

The particle-size control section is 10 to 17 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 30 to 50 inches thick. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist and 1 to 3 when dry.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry.

The C horizon has value of 3 to 5 when moist and 4 to 7 when dry. Below a depth of 43 inches it is weakly effervescent in some pedons.

Oliphant Series

The Oliphant series consists of deep, well drained soil on terraces and terrace scarps. These soils formed in loess that has been deposited over lacustrine sediment. Slopes are 0 to 25 percent.

Typical pedon of Oliphant silt loam, 0 to 3 percent slopes, in the NW1/4SE1/4SE1/4 of sec. 7, T. 5 N., R. 36 E.

Ap1—0 to 8 inches; very dark brown (10YR 2/2) silt loam, brown (10YR 5/3) dry; strong fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine irregular pores; slightly acid; abrupt wavy boundary.

Ap2—8 to 12 inches; very dark brown (10YR 2/2) silt loam, brown (10YR 5/3) dry; strong medium platy structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; neutral; clear wavy boundary.

Bw1—12 to 19 inches; very dark grayish brown (10YR 3/2), silt loam, brown (10YR 5/3) dry; moderate

medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; mildly alkaline; gradual wavy boundary.

Bw2—19 to 30 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; moderately alkaline; clear wavy boundary.

Bk1—30 to 36 inches; dark brown (10YR 3/3) silt loam, light brownish gray (10YR 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 5 percent pebbles; strongly effervescent; disseminated lime and lime segregated in seams and soft masses; strongly alkaline; clear wavy boundary.

Bk2—36 to 56 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; massive; soft, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 5 percent pebbles; slightly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

2Ck3—56 to 60 inches; grayish brown (2.5Y 5/2) gravelly silt loam, light gray (2.5Y 7/2) dry; massive; very hard, very firm, slightly sticky and slightly plastic; few very fine tubular pores; 20 percent pebbles; violently effervescent; disseminated lime; strongly alkaline.

The particle-size control section is 12 to 17 percent clay and is less than 15 percent sand that is coarser than very fine sand. Depth to carbonates ranges from 20 to 43 inches. The mollic epipedon is 12 to 19 inches thick. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry.

The 2Ck horizon has hue of 2.5Y or 10YR, value of 3 to 6 when moist and 5 to 8 when dry, and chroma of 2 or 3 when moist or dry.

Onyx Series

The Onyx series consists of deep, well drained soil on flood plains. It formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Onyx silt loam, 0 to 3 percent slopes, in the NW1/4NW1/4NW1/4 of sec. 3, T. 1 N., R. 32 E.

Ap1—0 to 5 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; strong medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine irregular pores; neutral; clear wavy boundary.

Ap2—5 to 12 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine irregular pores; neutral; clear wavy boundary.

Bw1—12 to 20 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral; clear wavy boundary.

Bw2—20 to 30 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; neutral; clear wavy boundary.

C—30 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; neutral.

The particle-size control section is is 10 to 17 percent clay and is less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 20 inches to more than 40 inches thick. The profile is neutral or mildly alkaline. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist and 2 to 4 when dry.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when dry.

The C horizon has value of 3 or 4 moist, and it has chroma of 2 or 3 when moist or dry.

Palouse Series

The Palouse series consists of deep, well drained soils on hills of the Blue Mountains. These soils formed in loess. Slopes are 1 to 40 percent.

Typical pedon of Palouse silt loam, 20 to 35 percent slopes, in the SW1/4NE1/4SW1/4 of sec. 24, T. 4 N., R. 35 E.

A1—0 to 6 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine irregular pores; neutral; clear smooth boundary.

A2—6 to 14 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very

fine roots; many fine irregular pores; neutral; clear smooth boundary.

BA—14 to 27 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and coarse subangular blocky structure; slightly hard, friable slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; neutral; clear wavy boundary.

Bw1—27 to 49 inches; very dark grayish brown (10YR 3/2, crushed) silt loam, brown (10YR 5/3) dry; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; neutral; abrupt wavy boundary.

Bw—49 to 62 inches; dark grayish brown (10YR 4/2) silt loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; neutral.

The particle size control section is 20 to 35 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 20 to 60 inches thick. Depth to the basalt is 60 inches or more.

The A horizon has chroma of 1 or 2 when moist or dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 to 4 when moist or dry. It is heavy silt loam or silty clay loam.

Pedigo Series

The Pedigo series consists of deep, somewhat poorly drained soils on flood plains. These soils formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Pedigo silt loam, 0 to 3 percent slopes, in the NW1/4NW1/4 of sec. 6, T. 3 N., R. 29 E.

Ak1—0 to 4 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak thin platy structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; slightly effervescent; disseminated lime; strongly alkaline; abrupt smooth boundary.

Ak2—4 to 10 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; strongly effervescent; disseminated lime; strongly alkaline; clear smooth boundary.

Ak3—10 to 21 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine pores; slightly effervescent; disseminated lime; strongly alkaline; clear wavy boundary.

C1—21 to 28 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; massive; soft, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; mildly alkaline; gradual wavy boundary.

C2—28 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; massive; soft, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; neutral.

The particle-size control section is 10 to 17 percent clay and is less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 20 inches to more than 40 inches thick. Depth to basalt is 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 to 3 when moist or dry. It is silt loam or loamy fine sand.

The C horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 1 to 3 when moist or dry.

Pilot Rock Series

The Pilot Rock series consists of moderately deep, well drained soils on fan terraces and terrace scarps. These soils formed in loess overlying cemented alluvium. Slopes are 1 to 40 percent.

Typical pedon of Pilot Rock silt loam, 1 to 7 percent slopes, in the SE1/4NE1/4SW1/4 sec. 3, T. 1 N., R. 32 E.

Ap1—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine irregular pores; neutral; clear wavy boundary.

Ap2—4 to 10 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; neutral; clear wavy boundary.

Bw—10 to 20 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; mildly alkaline; clear wavy boundary.

Bk—20 to 27 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

2Ckqm—27 to 45 inches; very pale brown (10YR 7/3) very gravelly duripan, white (10YR 8/2) dry; massive; indurated in the upper part with a laminar cap and strongly cemented in the lower part; extremely hard, extremely firm, nonsticky and nonplastic; strongly effervescent; strongly alkaline; abrupt wavy boundary.

2Ck1—45 to 51 inches; pale brown (10YR 6/3) very gravelly sandy loam, light gray (10YR 7/2) dry; massive; hard, firm, nonsticky and nonplastic; 5 percent cobbles and 40 percent pebbles; strongly effervescent; disseminated lime and lime segregated in seams; strongly alkaline; clear wavy boundary.

2Ck2—51 to 60 inches; very pale brown (10YR 7/3) very gravelly sand, white (10YR 8/2) dry; single grain; loose, nonsticky and nonplastic; 10 percent cobbles and 45 percent pebbles; strongly effervescent; disseminated lime and lime segregated in seams; strongly alkaline.

The particle-size control section is 10 to 17 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 10 to 19 inches thick. The duripan is at a depth of 20 to 40 inches.

The A horizon has chroma of 2 or 3 when moist or dry.

The Bw horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The Bk horizon has value of 4 or 5 when moist and 6 or 7 when dry, and it has chroma of 1 to 4 when moist or dry.

The duripan is indurated in the upper 1 to 5 inches and is weakly to strongly cemented below this depth. It grades to loose very gravelly or extremely gravelly sand many feet thick.

Potamus Series

The Potamus series consists of deep, well drained soils on terraces. These soils formed in mixed alluvium. Slopes are 0 to 2 percent.

Typical pedon of Potamus gravelly loam, 0 to 2 percent slopes, in the SW1/4NE1/4SW1/4 of sec. 13, T. 5 S., R. 31 E.

A1—0 to 4 inches; black (10YR 2/1) gravelly loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many fine irregular pores; 15 percent pebbles; neutral; clear wavy boundary.

A2—4 to 15 inches; black (10YR 2/1) gravelly clay loam, very dark gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many fine and medium roots; many fine tubular pores; 15 percent pebbles; neutral; clear wavy boundary.

Bw—15 to 45 inches; dark brown (10YR 3/3) very gravelly clay loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and medium roots; many fine tubular pores; 15 percent cobbles and 40 percent pebbles; neutral; gradual wavy boundary.

C—45 to 60 inches; dark brown (10YR 3/3) extremely gravelly clay loam, yellowish brown (10YR 5/4) dry; massive; slightly hard, friable, sticky and plastic; few fine and medium roots; many fine tubular pores; 25 percent cobbles and 55 percent pebbles; neutral.

The particle size control section is 28 to 34 percent clay and 35 to 65 percent rock fragments. The mollic epipedon is 10 to 19 inches thick. Depth to basalt is 60 inches or more.

The upper part of the the A horizon has chroma of 1 or 2 when moist or dry. It is 0 to 10 percent cobbles and 15 to 25 percent pebbles.

The lower part of the A horizon, where present, has chroma of 1 or 2 when moist or dry. It is gravelly loam or gravelly clay loam. It is 0 to 10 percent cobbles and 15 to 25 percent pebbles.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. It is very gravelly clay loam or extremely gravelly clay loam. It is 10 to 30 percent cobbles and 25 to 60 percent pebbles.

The C horizon is similar to the above Bw horizon except that it is structureless.

Powder Series

The Powder series consists of deep, well drained soils on flood plains. These soils formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Powder silt loam, 0 to 3 percent slopes, in the SW1/4SW1/4 of sec. 7, T. 3 N., R. 29 E.

Ak1—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine irregular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ak2—3 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry;

moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine pores; strongly effervescent; moderately alkaline; clear wavy boundary.

BAk—15 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw1—18 to 23 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; moderately alkaline; abrupt wavy boundary.

Bw2—23 to 27 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; moderately alkaline; clear wavy boundary.

C1—27 to 41 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; moderately alkaline; clear wavy boundary.

C2—41 to 57 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, friable, few very fine tubular pores; slightly sticky and nonplastic; moderately alkaline; clear wavy boundary.

2C3—57 to 60 inches; pebbles.

The particle-size control section is 10 to 17 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 20 to 32 inches thick. The solum is mildly alkaline or moderately alkaline and is calcareous. Depth to the basalt is 60 inches or more.

The Ak horizon has chroma of 2 or 3 when dry. It is dominantly silt loam, but in some areas it is fine sandy loam or very fine sandy loam.

The Bw horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The C horizon has value of 3 or 4 moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry. The lower part of the C horizon has pebbles at a depth of 50 to 60 inches.

Prosser Series

The Prosser series consists of moderately deep, well drained soils on terrace scarps. These soils formed in loess. Slopes are 12 to 40 percent.

Typical pedon of Prosser silt loam, 12 to 20 percent slopes, in the SE1/4NW1/4 of sec. 14, T. 2 N., R. 29 E.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine irregular pores; 5 percent pebbles; neutral; clear smooth boundary.

A2—2 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; 5 percent pebbles; neutral; clear wavy boundary.

Bw1—7 to 15 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; 5 percent pebbles; neutral; clear wavy boundary.

Bw2—15 to 21 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 10 percent pebbles 2 to 5 millimeters in diameter; mildly alkaline; abrupt wavy boundary.

2R—21 inches; basalt.

The particle-size control section is 5 to 12 percent clay and 15 percent or more sand that is fine or coarser. Depth to bedrock ranges from 20 to 40 inches.

The A horizon has value of 3 or 4 moist, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 5 or 6 when dry.

Quincy Series

The Quincy series consists of deep, excessively drained soils on strath terraces of the Columbia River. These soils formed in eolian sand and gravelly alluvium. Slopes are 0 to 25 percent.

Typical pedon of a Quincy loamy fine sand in an area of Quincy-Rock outcrop complex, 1 to 20 percent slopes, in the NW1/4NE1/4SE1/4 of sec. 14, T. 5 N., R. 29 E.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak thick platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine irregular pores; 5 percent fine pebbles; mildly alkaline; clear wavy boundary.

C1—4 to 27 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine irregular pores; 5

percent fine pebbles; mildly alkaline; clear smooth boundary.

Ck1—27 to 39 inches; dark gray (10YR 4/1) fine sand, gray (10YR 6/1) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine irregular pores; 10 percent fine pebbles; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

Ck2—39 to 60 inches; dark grayish brown (2.5Y 4/2) fine sand, light brownish gray (2.5Y 6/2) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine irregular pores; 5 percent fine pebbles; strongly effervescent; disseminated lime; moderately alkaline.

The particle-size control section ranges from sand to loamy fine sand and has less than 5 percent clay. Less than 75 percent of the sand is very coarse, coarse, and medium. Depth to basalt is 60 inches or more.

The A horizon has a value of 3 or 4 when moist and 4 to 6 when dry, and it has chroma of 1 to 3 when moist or dry. It is loamy fine sand or fine sand.

The C horizon has hue of 10YR or 2.5Y, value of 3 or 4 when moist and 4 to 6 when dry, and it has chroma of 1 to 3 when moist or dry. It is a loamy fine sand, fine sand, or sand. In some pedons very gravelly loamy fine sand, fine sand, or sand is below a depth of 40 inches in some pedons.

Quinton Series

The Quinton series consists of moderately deep, excessively drained soils on strath terraces of the Columbia River. These soils formed in eolian sand. Slopes are 0 to 5 percent.

Typical pedon of a Quinton loamy fine sand in an area of Winchester-Quinton complex, 0 to 5 percent slopes, in the SE1/4NW1/4NW1/4 of sec. 19, T. 5 N., R. 30 E.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak medium platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots; few very fine irregular pores; 5 percent pebbles; neutral; clear wavy boundary.

C1—6 to 18 inches; very dark grayish brown (10YR 3/2) loamy fine sand, brown (10YR 4/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; few very fine irregular pores; 5 percent pebbles; neutral; gradual wavy boundary.

C2—18 to 29 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; few very fine irregular pores; 5 percent pebbles; mildly alkaline; clear wavy boundary.

C3—29 to 35 inches; very dark grayish brown (10YR 3/2) gravelly loamy fine sand, grayish brown (10YR 5/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; few very fine irregular pores; 5 percent cobbles and 20 percent pebbles; mildly alkaline; abrupt wavy boundary.

2R—35 inches; basalt.

The particle-size control section is fine sand or loamy fine sand. The content of rock fragments in the lower part ranges from 0 to 30 percent. It is less than 75 percent medium, coarse, and very coarse sand and less than 5 percent clay. Depth to basalt is 20 to 40 inches.

The profile has hue of 10YR or 2.5Y. It has value of 3 to 5 when moist and 4 to 7 when dry, and it has chroma of 2 or 3 when moist or dry.

Ritzville Series

The Ritzville series consists of deep, well drained soils on hills. These soils formed in loess. Slopes are 0 to 50 percent.

Typical pedon of Ritzville silt loam, 7 to 12 percent slopes, in the NE1/4SW1/4 of sec. 26, T. 5 N., R. 31 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; strong fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine irregular pores; neutral; clear smooth boundary.

AB—8 to 22 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to angular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; mildly alkaline; clear wavy boundary.

Bw—22 to 30 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium prismatic structure parting to angular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; mildly alkaline; clear wavy boundary.

Bk—30 to 60 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; strong medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; violently effervescent; disseminated lime and segregated in seams and filaments; moderately alkaline.

The particle-size control section is 5 to 10 percent clay and less than 15 percent sand that is coarser than very fine sand. There is soft powdery lime at a depth of 20 to 40 inches. The mollic epipedon is 10 to 15 inches thick. Depth to basalt is 60 inches or more.

The Ap horizon has value of 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is a silt loam or very fine sandy loam.

The Bw horizon has value of 3 or 4 when moist and 4 to 6 when dry.

The Bk horizon has value of 4 or 5 when moist and 5 to 7 when dry.

Rockly Series

The Rockly series consists of very shallow, well drained soils on ridges in the foothills of the Blue Mountains. These soils formed in loess and residuum. Slopes are 2 to 20 percent.

Typical pedon of Rockly very cobbly loam in an area of Waha-Rockly complex, 2 to 20 percent slopes, in the SW1/4NE1/4SW1/4 of sec. 36, T. 2 N., R. 34 E.

A—0 to 2 inches; dark reddish brown (5YR 3/3) very cobbly loam, brown (7.5YR 4/3) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; very fine irregular pores; 35 percent cobbles and 20 percent pebbles; neutral; clear wavy boundary. boundary.

Bw—2 to 6 inches; dark reddish brown (5YR 3/3) very cobbly loam, brown (7.5YR 4/4) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; 40 percent cobbles and 20 percent pebbles; neutral; abrupt wavy boundary.

2R—6 inches; basalt.

The particle-size control section is 20 to 30 percent clay and 35 to 75 percent rock fragments. The thickness of the mollic epipedon and solum and the depth to basalt range from 5 to 12 inches.

The A horizon has hue of 10YR to 5YR, value of 2 or 3 when moist and 4 or 5 when dry, and has chroma of 2 or 3 when moist or dry.

The B horizon has hue of 10YR to 5YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 3 or 4 when moist or dry.

Sagehill Series

The Sagehill series consists of deep, well drained soils on terraces of the Columbia River. These soils formed in eolian sand deposited over lacustrine sediment. Slopes are 2 to 12 percent.

Typical pedon of Sagehill fine sandy loam, 2 to 5 percent slopes, in the NW1/4NW1/4NE1/4 of sec. 13, T. 4 N., R. 29 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; loose, very friable, nonsticky and nonplastic; many very fine roots; many very fine irregular pores; mildly alkaline; gradual smooth boundary.

Bw—8 to 20 inches; dark brown (10YR 3/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; loose, very friable, nonsticky and nonplastic; common very fine roots; many very fine irregular pores; mildly alkaline; clear smooth boundary.

BCk1—20 to 27 inches; brown (2.5YR 4/3) very fine sandy loam, light brownish gray (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine irregular pores; slightly effervescent; disseminated lime; mildly alkaline; gradual wavy boundary.

2Ck2—27 to 35 inches; brown (2.5YR 4/3) silt loam, light brownish gray (10YR 6/3) dry; weak medium platy structure; slightly hard, firm, slightly sticky and nonplastic; common very fine roots; many very fine irregular pores; strongly effervescent; disseminated lime and lime segregated in seams and filaments; strongly alkaline; clear wavy boundary.

2Ck3—35 to 65 inches; brown (2.5Y 4/3) silt loam, light brownish gray (10YR 6/3) dry; weak medium platy structure; hard, firm, slightly sticky and nonplastic; few very fine roots; many very fine irregular pores; strongly effervescent; disseminated lime; strongly alkaline.

The particle-size control section is 2 to 8 percent clay and 15 percent or more sand that is coarser than very fine sand. The calcic horizon is at a depth of 15 to 30 inches. Basalt or a hardpan is generally at a depth of 60 inches or more.

The A and B horizons are fine sandy loam to very fine sandy loam. They have value of 5 or 6 when dry and chroma of 2 or 3 when moist or dry.

The 2C horizon is silt loam to very fine sandy loam. It has hue of 2.5Y or 10YR, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry.

Shano Series

The Shano series consists of deep, well drained soil on terraces and terrace scarps. These soils formed in loess deposited over lacustrine sediment. Slopes are 2 to 40 percent.

Typical pedon of Shano silt loam, 2 to 7 percent slopes, in the NW1/4SW1/4NW1/4 of sec. 17, T. 3 N., R. 30 E.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) coarse silt loam, grayish brown (10YR 5/2) dry; weak very thin platy structure; soft, very friable, slightly sticky and nonplastic; many very fine roots; many fine irregular pores; mildly alkaline; abrupt wavy boundary.

Bw1—2 to 6 inches; dark brown (10YR 3/3) coarse silt loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; many fine tubular pores; mildly alkaline; clear wavy boundary.

Bw2—6 to 18 inches; dark brown (10YR 3/3) coarse silt loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; many fine tubular pores; mildly alkaline; clear wavy boundary.

BCk1—18 to 43 inches; grayish brown (10YR 5/2) coarse silt loam, light gray (10YR 7/2) dry; massive; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; common fine tubular pores; violently effervescent; disseminated lime and segregated in seams and filaments; strongly alkaline; clear smooth boundary.

BCk2—43 to 65 inches; dark brown (10YR 4/3) coarse silt loam, pale brown (10YR 6/3) dry; massive; soft, very friable, slightly sticky and nonplastic; common very fine roots; common fine tubular pores; strongly effervescent; disseminated lime and lime segregated in seams and filaments; strongly alkaline.

The particle-size control section is 5 to 10 percent clay and less than 15 percent sand that is coarser than very fine sand. The solum is 12 to 26 inches thick. Depth to basalt or a hardpan is 40 to 60 inches or more.

The A horizon has value of 3 to 5 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry. It is a silt loam or very fine sandy loam. It is neutral to moderately alkaline.

The Bw horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry.

The BCk horizon has value of 4 or 5 when moist and 5 to 7 when dry, and it has chroma of 2 or 3 when moist or dry.

Silvies Series

The Silvies series consists of deep, poorly drained soils in basins. These soils formed in old alluvium and lacustrine sediment. Slopes are 0 to 3 percent.

Typical pedon of a Silvies silt loam in an area of Silvies-Winom complex, 0 to 3 percent slopes, in the SW1/4NE1/4 of sec. 9, T. 4 S., R. 31 E.

A1—0 to 6 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; strong fine and medium granular structure; soft, friable, slightly sticky and nonplastic; many very fine roots; many very fine irregular pores; slightly acid; clear smooth boundary.

A2—6 to 15 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; strong medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; neutral; gradual wavy boundary.

A3—15 to 25 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine tubular pores; neutral; gradual wavy boundary.

AC—25 to 35 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; common medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; neutral; gradual wavy boundary.

C—35 to 60 inches; dark grayish brown (2.5Y 4/2) clay, light brownish gray (10YR 6/2) dry; many medium prominent strong brown (7.5YR 5/6) mottles; massive; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; neutral.

The particle-size control section is 35 to 60 percent clay. The soil has an aquic moisture regime. Depth to basalt is 60 inches or more.

The A horizon has hue of 10YR or is neutral, has value of 1 or 2 when moist, and has chroma of 0 or 1 when moist or dry.

The AC horizon has hue of 10YR or 2.5Y or is neutral, has value of 1 to 4 when moist and 3 to 6 when dry, and has chroma of 0 to 2 when moist and 1 or 2 when dry.

The C horizon has hue of 10YR or 2.5Y, value of 1 to 4 when moist and 3 to 6 when dry, and chroma of 0 to 2 when moist and 1 or 2 when dry.

Stanfield Series

The Stanfield series consists of moderately deep, moderately well drained soils on terraces. These soils formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Stanfield silt loam, 0 to 3 percent slopes, in the NW1/4SW1/4SW1/4 of sec. 17, T. 3 N., R. 28 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) coarse silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots; many very fine irregular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

Akn—6 to 13 inches; brown (10YR 4/3) coarse silt loam, light brownish gray (10YR 6/2) dry; massive; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots; many very fine pores; strongly effervescent; disseminated lime; strongly alkaline; gradual irregular boundary.

ACkn—13 to 22 inches; brown (10YR 4/3) coarse silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, very friable, nonsticky and slightly plastic; few very fine roots; many very fine and few fine pores; few grayish brown to very dark grayish brown (when moist) calcareous firm nodules 1/4 to 1 inch in diameter; strongly effervescent; disseminated lime; very strongly alkaline; abrupt wavy boundary.

2Ckqm—22 to 41 inches; brown (10YR 4/3) and pale brown (10YR 6/3) dry; massive; strongly cemented hardpan with indurated silica coatings on surface and in some pores; few very fine roots; many very fine pores; strongly effervescent; disseminated lime; clear wavy boundary.

2Ck—41 to 58 inches; brown (10YR 4/3) coarse silt loam, light brownish gray (10YR 6/2) dry; massive; slightly hard, very friable, nonsticky and slightly plastic; few very fine roots; many very fine and few fine pores; strongly effervescent; disseminated lime; moderately alkaline; abrupt smooth boundary.

2Ckqm—58 to 70 inches; dark grayish brown (10YR 4/2), light brownish gray (10YR 6/2) dry; massive; strongly cemented with silica coatings on surface and in some pores; many very fine and few fine pores; strongly effervescent with mycelial lime; clear smooth boundary.

3C—70 to 86 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; few fine reddish brown mottles; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and common fine pores; mildly alkaline.

The particle-size control section is very fine sandy loam, silt loam, or loam. It is less than 18 percent clay and less than 15 percent sand that is coarser than very fine sand. Depth to basalt is 60 inches or more. The duripan is at a depth of 20 to 40 inches. The duripan commonly is 7 to 20 inches thick, but it ranges from 4 to 30 inches in thickness. In some pedons there is a series of pans.

The Ap, Akn, and ACkn horizons have value of 3 or 4 when moist and 5 to 7 when dry, and they have chroma of 2 or 3 when moist or dry.

The 2C horizon has hue of 10YR or 2.5YR, value of 3 or 4 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry.

Starbuck Series

The Starbuck series consists of shallow, well drained soils on strath terraces of the Columbia River. These soils formed in loess and eolian sand. Slopes are 0 to 20 percent.

Typical pedon of Starbuck very fine sandy loam, 2 to 20 percent slopes, in the SE1/4SW1/4SW1/4 of sec. 9, T. 5 N., R. 30 E.

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, brown (10YR 5/3) dry; weak medium platy structure parting to weak very fine granular; soft, very friable, slightly sticky and nonplastic; many very fine roots; many very fine pores; neutral; abrupt smooth boundary.

A2—3 to 10 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few fine and very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

Bw—10 to 18 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; massive; soft, very friable, nonsticky and nonplastic; few fine and very fine roots; common very fine tubular pores; 5 percent pebbles; neutral; abrupt wavy boundary.

2R—18 inches; basalt.

The particle-size control section is 5 to 15 percent clay and more than 15 percent sand that is coarser than very fine sand. It is 5 to 35 percent rock fragments. Basalt is at a depth of 12 to 20 inches.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 to 4 when moist or dry.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry.

Taunton Series

The Taunton series consists of moderately deep, well drained soils on strath terraces of the Columbia River. These soils formed in eolian sand over cemented alluvium. Slopes are 1 to 7 percent.

Typical pedon of Taunton fine sandy loam, 1 to 7 percent slopes, in the SE1/4SE1/4SW1/4 of sec. 19, T. 4 N., R. 29 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak very thin platy structure parting to weak very fine granular; soft, very friable, slightly sticky and nonplastic; many very fine roots; many very fine pores; neutral; clear wavy boundary.

Bw—6 to 11 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; neutral; gradual wavy boundary.

C—11 to 26 inches; dark brown (10YR 3/3) fine sandy loam, light brownish gray (10YR 6/2) dry; massive; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; common very

fine tubular pores; mildly alkaline; abrupt wavy boundary.

2Ckqm1—26 to 29 inches; olive brown (2.5Y 4/4) very gravelly duripan, white (N 8/0) and light brownish gray (2.5Y 6/2) dry; massive; indurated; white opaline cap 2 millimeters thick at a depth of 29 inches; many opaline coatings on plates and vertical fractures; strongly effervescent; abrupt smooth boundary.

2Ckqm2—29 to 67 inches; olive brown (2.5Y 4/4) duripan, white (N 8/0) and pale brown (10YR 6/3) dry; platy; indurated; moderately effervescent to a depth of 40 inches; thick opaline coatings on plates and vertical fractures.

The particle-size control section is 5 to 12 percent clay and 15 percent or more sand that is coarser than very fine sand. The solum is 10 to 20 inches thick. The duripan is at a depth of 20 to 40 inches.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry.

The B horizon has value of 3 to 6 when moist and 5 to 7 when dry, and it has chroma of 2 or 3 when moist or dry.

The C horizon has the same color range as the Bw horizon. It is gravelly in many pedons.

Thatuna Series

The Thatuna series consists of deep, moderately well drained soils on plateaus of the Blue Mountains. These soils formed in loess mixed with small amounts of ash. Slopes are 1 to 20 percent.

Typical pedon of Thatuna silt loam, 1 to 7 percent slopes, in the SW1/4SE1/4SE1/4 of sec. 14, T. 3 N., R. 35 E.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; strong medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.

A—9 to 18 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine and fine roots; common very fine tubular pores; neutral; abrupt wavy boundary.

E—18 to 30 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine and fine roots; common very fine tubular pores; few faint mottles; neutral; abrupt smooth boundary.

2Btb1—30 to 37 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; strong fine and medium angular blocky structure; hard, firm, sticky and plastic; few very fine and fine roots; few very fine tubular pores; few faint mottles; common thin clay films on ped faces and in pores; neutral; clear smooth boundary.

2Btb2—37 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; strong fine and medium angular blocky structure; hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; common thin clay films on ped faces and in pores; 5 percent pebbles; neutral.

The mollic epipedon is 24 to 36 inches thick. Depth to the 2Btb horizon is 29 to 40 inches. Depth to basalt is 60 inches or more.

The E horizon has value of 3 to 5 when moist and 5 to 7 when dry, and it has chroma of 3 or 4 when moist or dry.

The 2Btb horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry, and chroma of 3 or 4 when moist or dry.

Tolo Series

The Tolo series consists of deep, well drained soils on plateaus of the Blue Mountains. These soils formed in volcanic ash over a buried soil. Slopes are 3 to 35 percent.

Typical pedon of Tolo silt loam, 3 to 15 percent slopes, in the NE1/4NW1/4NW1/4 of sec. 32, T. 4 N., R. 37 E.

O—1 inch to 0; loose layer of pine and fir needles.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, medium, and coarse roots; many fine irregular pores; neutral; clear wavy boundary.

Bw—4 to 22 inches; yellowish brown (10YR 5/4) silt loam, very pale brown (10YR 7/4) dry; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, medium, and coarse roots; common very fine irregular pores; neutral; abrupt wavy boundary.

2AB—22 to 36 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; weak medium and coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common medium and fine roots; many very fine tubular pores; neutral; gradual wavy boundary.

2Bwb—36 to 46 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; weak medium and coarse prismatic

structure parting to weak fine and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few medium and fine roots; many very fine tubular pores; neutral; clear wavy boundary.

2Btb—46 to 60 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine tubular pores; few thin clay films on faces of peds; neutral.

The ash mantle ranges from 20 to 40 inches in thickness. It has moist bulk density of less than 0.85 gram per cubic centimeter. Depth to basalt is 40 to 60 inches or more.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 to 3 when moist or dry.

The Bw horizon has hue of 10YR or 7.5YR, value of 3 to 5 when moist and 6 or 7 when dry, and chroma of 2 to 4 when moist or dry.

The 2Bb horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 to 4 when moist or dry. It is silt loam or silty clay loam, averages 18 to 34 percent clay, and has 0 to 35 percent coarse fragments.

Tolo Variant

The Tolo Variant consists of deep, poorly drained soils in concave areas. These soils formed in volcanic ash and alluvium. Slopes are 0 to 3 percent.

Typical pedon of Tolo Variant silt loam, 0 to 3 percent slopes, in the NE1/4NE1/4NE1/4 of sec. 12, T. 5 N., R. 37 E.

A1—0 to 6 inches; black (N 2/0) silt loam, dark gray (10YR 4/1) dry; strong fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; medium acid; clear smooth boundary.

A2—6 to 14 inches; black (N 2/0) silt loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; slightly acid; abrupt smooth boundary.

Bw—14 to 26 inches; grayish brown (10YR 5/2) silt loam, white (10YR 8/2) dry; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; neutral; gradual wavy boundary.

BC—26 to 60 inches; dark grayish brown (2.5Y 4/2) silt loam, light gray (10YR 7/2) dry; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; slightly acid.

Depth to basalt is 60 inches or more.

The A horizon has hue of 10YR or is neutral, and chroma of 0 or 1 when moist or dry.

The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 when moist and 6 to 8 when dry, and chroma of 1 or 2 when moist or dry.

Tutuilla Series

The Tutuilla series consists of deep, well drained soils on hills of the Blue Mountains. These soils formed in loess over metasedimentary material. Slopes or 1 to 35 percent.

Typical pedon of Tutuilla silty clay loam, 1 to 15 percent slopes, in the SE1/4SW1/4 of sec. 27, T. 3 S., R. 30 E.

A1—0 to 5 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; hard, friable, sticky and plastic; many fine and very fine roots; many very fine irregular pores; 5 percent pebbles; neutral; clear wavy boundary.

A2—5 to 19 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine and very fine roots; many very fine irregular and tubular pores; 5 percent pebbles; neutral; abrupt wavy boundary.

2Bt1—19 to 35 inches; dark grayish brown (2.5Y 4/2) clay, brown (10YR 4/3) dry; moderate coarse columnar structure; very hard, very firm, very sticky and very plastic; few very fine roots; common fine tubular pores; common moderately thick clay films in pores and on faces of peds; 15 percent cobbles and 10 percent pebbles; neutral; clear wavy boundary.

2Bt2—35 to 50 inches; dark brown (10YR 3/3) clay, dark brown (10YR 4/3) dry; moderate medium angular blocky structure; very hard, firm, very sticky and plastic; common fine tubular pores; common moderately thick clay films in pores and on faces of peds; 5 percent cobbles and 10 percent pebbles; neutral; abrupt wavy boundary.

2Cr—50 to 60 inches; partially decomposed sedimentary material.

The particle-size control section is 5 to 15 percent rock fragments and 45 to 60 percent clay. Depth to the paralithic contact ranges 40 to 60 inches or more. The mollic epipedon is 14 to 19 inches thick.

The A horizon has value of 3 or 4 when dry, and it has chroma of 1 or 2 when moist. It has 28 to 40 percent clay.

The 2B horizon has hue of 10YR to 2.5Y, value of 2 to 4 moist or dry, and chroma of 2 or 3 when moist and 3 or 4 when dry. It is 5 to 10 percent pebbles and 0 to 15 percent cobbles. It is 45 to 60 percent clay.

Umapine Series

The Umapine series consists of deep, somewhat poorly drained soils on terraces. These soils formed in silty alluvium. Slopes are 0 to 3 percent.

Typical pedon of Umapine silt loam, 0 to 3 percent slopes, in the NE1/4NW1/4NE1/4 of sec. 22, T. 6 N., R. 34 E.

Akn—0 to 7 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate very fine platy structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium roots; many very fine irregular pores; strongly effervescent; disseminated lime; strongly alkaline; clear wavy boundary.

ABkn—7 to 25 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; common very fine tubular pores; strongly effervescent; disseminated lime; very strongly alkaline; clear wavy boundary.

BCk1—25 to 32 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; massive; hard, firm, nonsticky and nonplastic; common very fine and fine roots; common very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; clear wavy boundary.

BCk2—32 to 44 inches; grayish brown (10YR 5/2) silt loam, white (10YR 8/2) dry; massive; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots; common very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline; gradual wavy boundary.

BCk3—44 to 48 inches; light brownish gray (10YR 6/2) silt loam, white (10YR 8/1) dry; massive; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots; common very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline; abrupt wavy boundary.

2Ckb—48 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; massive; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots; common very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline.

The particle-size control section is less than 18 percent clay and is less than 15 percent sand that is coarser than very fine sand. The exchangeable sodium content exceeds 15 percent in the upper 20 inches and decreases as depth decreases. The profile is calcareous in all parts between depths of 10 and 20 inches. Depth to basalt is 60 inches or more.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 when moist and 5 or 6 when dry, and chroma of 1 to 3 when moist or dry.

The BC horizon have hue of 10YR or 2.5Y, value of 3 to 6 when moist and 5 to 8 when dry, and chroma of 1 or 2 when moist or dry.

Umatilla Series

The Umatilla series consists of deep, well drained soils on hills of the Blue Mountains. These soils formed in loess and colluvium. Slopes are 15 to 70 percent.

Typical pedon of a Umatilla loam in an area of Umatilla-Kahler-Gwin association, 35 to 70 percent slopes, in the NE1/4 of sec. 23, T. 2 S., R. 33 E.

O—2 inches to 0; partially decomposed forest litter.

A1—0 to 3 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, fine, medium and coarse roots; many very fine irregular pores; 5 percent pebbles; neutral; clear wavy boundary.

A2—3 to 12 inches; dark brown (7.5YR 3/2) loam, brown (10YR 4/3 dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; common very fine tubular pores; 15 percent cobbles and 15 percent pebbles; neutral; clear wavy boundary.

2BA—12 to 28 inches; dark brown (7.5YR 3/2) cobbly clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many very fine, fine, medium, and coarse roots; common very fine tubular pores; 15 percent cobbles and 15 percent pebbles; neutral; clear wavy boundary.

2Bw—28 to 60 inches; dark brown (10YR 3/3) very cobbly clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine, fine, and medium roots; common very fine tubular pores; 35 percent cobbles and 25 percent pebbles; neutral.

The particle-size control section is 35 to 65 percent rock fragments and 28 to 34 percent clay. The mollic epipedon is 20 to 30 inches thick. The depth to basalt is 60 inches or more.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 3 or 4 when dry, and chroma of 2

or 3 when moist or dry. It is 0 to 15 percent rock fragments.

The 2BA horizon, where present, has hue of 7.5YR or 10YR, and it has chroma of 2 or 3 when moist and 2 to 4 when dry. It is loam, clay loam, or silty clay loam and has 10 to 20 percent cobbles and 5 to 20 percent pebbles.

The 2Bw horizon has hue of 7.5YR or 10YR, chroma of 2 or 3 when moist and 3 or 4 when dry. It is clay loam or silty clay loam and has 10 to 25 percent pebbles and 20 to 40 percent cobbles.

Veazie Series

The Veazie series consists of deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent.

Typical pedon of Veazie silt loam, 0 to 3 percent slopes, in the NW1/4SE1/4NW1/4 of sec. 24, T. 5 N., R. 36 E.

A1—0 to 3 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to moderate fine and medium granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine irregular pores; neutral; clear smooth boundary.

A2—3 to 10 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine irregular pores; neutral; clear wavy boundary.

AC—10 to 18 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 4/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular pores; 5 percent pebbles; neutral; clear wavy boundary.

C1—18 to 23 inches; very dark grayish brown (10YR 3/2) very gravelly silt loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; 5 percent cobbles and 35 percent pebbles; neutral; abrupt wavy boundary.

2C2—23 to 30 inches; dark brown (7.5YR 3/2) extremely gravelly loamy sand, brown (7.5YR 4/4) dry; single grain; loose, nonsticky and nonplastic; few roots; many fine irregular pores; 15 percent cobbles and 65 percent pebbles; neutral; gradual wavy boundary.

2C3—30 to 51 inches; very dark grayish brown (10YR 3/2) extremely cobbly sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; many fine irregular pores; 50 percent cobbles and 25 percent pebbles; neutral; gradual wavy boundary.

2C4—51 to 60 inches; very dark grayish brown (10YR 3/2) very cobbly loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine irregular pores; 35 percent cobbles and 25 percent pebbles; neutral.

The upper part of the particle-size control section is silt loam or loam and has 10 to 18 percent clay and more than 15 percent sand that is coarser than very fine sand. The 2C horizon is sand or loamy sand and is 35 to 75 percent rock fragments. The mollic epipedon is 20 to 30 inches thick. Depth to the 2C horizon is 20 to 40 inches.

The A horizon has chroma of 1 or 2 when moist or dry. It is dominantly silt loam but ranges from cobbly loam to cobbly silt loam.

The AC horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist and 1 to 3 when dry.

The C horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The 2C horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 to 4 when moist or dry.

Vitrandepts

Vitrandepts consist of deep, well drained soils in depressional areas and on fans. These soils formed in volcanic ash and loess. Slopes are 0 to 5 percent.

Reference pedon of Vitrandepts, 0 to 5 percent slopes, in the NW1/4NW1/4NW1/4 of sec. 13, T. 1 N., R. 32 E.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; common very fine irregular pores; neutral; clear smooth boundary.

A2—2 to 10 inches; very dark grayish brown (10YR 3/2) coarse silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine tubular pores; neutral; clear wavy boundary.

C1—10 to 19 inches; brown (10YR 4/3) fine sandy loam, light gray (10YR 7/2) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; neutral; clear wavy boundary.

C2—19 to 23 inches; brown (10YR 4/3) very fine sandy loam, light gray (10YR 7/2) dry; massive; soft, very

friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; neutral; clear wavy boundary.

C3—23 to 35 inches; pale brown (10YR 6/3) very fine sandy loam, white (10YR 8/1) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; neutral; abrupt wavy boundary.

2Ck1—35 to 45 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; slightly effervescent; moderately alkaline; clear wavy boundary.

2Ck2—45 to 54 inches; brown (10YR 5/3) silt loam, light gray (10YR 7/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; violently effervescent; moderately alkaline; clear wavy boundary.

2Ck3—54 to 60 inches; brown (10YR 5/3) gravelly silt loam, light gray (10YR 7/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 25 percent pebbles; violently effervescent; moderately alkaline.

Depth to basalt is 40 to 60 inches or more. Depth to the 2C horizon is 20 inches to more than 60 inches. The profile has an ochric or mollic epipedon.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 2 or 3 when moist or dry. The texture ranges from loamy fine sand to silt loam.

The C horizon has value of 4 to 7 when moist and 6 to 8 when dry, and it has chroma of 1 to 3 when moist or dry. It ranges from silt loam to fine sandy loam.

The 2C horizon, where present, has value of 3 to 5 when moist and 5 to 7 when dry, and it has chroma of 2 or 3 when moist or dry. It is silt loam and is 0 to 35 percent rock fragments.

Waha Series

The Waha series consists of moderately deep, well drained soils on hills of the Blue Mountains. These soils formed in loess and residuum. Slopes are 1 to 40 percent.

Typical pedon of Waha silty clay loam, 12 to 25 percent slopes, in the SE1/4NE1/4SE1/4 of sec. 23, T. 4 N., R. 35 E.

A1—0 to 4 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; strong very fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine irregular pores; slightly acid; clear smooth boundary.

A2—4 to 12 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable, sticky and plastic; common very fine roots; common very fine tubular pores; neutral; abrupt wavy boundary.

BAt—12 to 20 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine prismatic structure parting to strong fine angular blocky; very hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; 5 percent pebbles; continuous moderately thick clay films in pores and on faces of peds; neutral; clear wavy boundary.

Bt2—20 to 28 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; strong medium prismatic structure parting to strong fine and medium subangular; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; 5 percent pebbles; many thin clay films in pores and on faces of peds; neutral; clear wavy boundary.

Bt3—28 to 38 inches; brown (10YR 4/3) gravelly silty clay loam, yellowish brown (10YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores; 5 percent cobbles and 20 percent pebbles; common thin clay films in pores and on faces of peds; neutral; abrupt wavy boundary.

2R—38 inches; basalt.

The particle-size control section is 27 to 34 percent clay and 15 percent or more sand that is fine or coarser. Thickness of the solum and depth to basalt range from 20 to 40 inches. The mollic epipedon is 20 to 30 inches thick.

The A horizon has value of 3 or 4 when dry and chroma 1 or 2 when moist.

The Bt horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist and 3 or 4 when dry.

Walla Walla Series

The Walla Walla series consists of deep, well drained soils on hills. These soils formed in loess. Slopes are 1 to 40 percent.

Typical pedon of Walla Walla silt loam, 1 to 7 percent slopes, in the SW1/4SW1/4 of sec. 35, T. 3 N., R. 32 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; many very fine tubular pores; neutral; clear smooth boundary.

BA—6 to 19 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; many very fine tubular pores; neutral; gradual wavy boundary.
Bw—19 to 44 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; common very fine tubular pores; neutral; clear wavy boundary.
BCk—44 to 60 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; few very fine tubular pores; strongly effervescent; disseminated lime; moderately alkaline.

The particle-size control section is 10 to 17 percent clay and less than 15 percent sand that is coarser than very fine sand. The mollic epipedon is 10 to 19 inches thick. Depth to secondary carbonates ranges from 43 inches to more than 60 inches. Depth to basalt is 60 inches or more. Depth to the weakly cemented hardpan commonly is more than 60 inches but is as little as 40 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry.

The Bw horizon has value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry.

The BC horizon has value of 3 to 5 when moist and 5 to 7 when dry, and chroma of 2 or 3 when dry.

Wanser Series

The Wanser series consists of deep, poorly drained soils on strath terraces of the Columbia River. These soils formed in sand derived from mixed sources. Slopes are 0 to 3 percent.

Typical pedon of Wanser loamy fine sand, 0 to 3 percent slopes, in the SW1/4SW1/4 of sec. 15, T. 5 N., R. 27 E.

Akn—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy fine sand, brown (10YR 5/3) dry; many fine distinct strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine irregular pores; strongly effervescent; disseminated lime; strongly alkaline; clear smooth boundary.
Ckn1—4 to 16 inches; very dark grayish brown (10YR 3/2) fine sand, brown (10YR 5/3) dry; many fine distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; many fine irregular pores; strongly effervescent; disseminated lime; strongly alkaline; gradual smooth boundary.
Ck2—16 to 38 inches; very dark grayish brown (10YR 3/2) loamy fine sand, light brown (10YR 6/3) dry; many fine distinct strong brown (7.5YR 5/8) mottles; massive; loose, nonsticky and nonplastic; few fine roots; many fine irregular pores; strongly effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.
Ck3—38 to 44 inches; dark gray (10YR 4/1) coarse sand, light brownish gray (10YR 6/2), pinkish gray (7.5YR 7/2) and dark gray (7.5YR 4/0) dry; single grain; loose, nonsticky and nonplastic; many fine irregular pores; strongly effervescent; disseminated lime; moderately alkaline; gradual smooth boundary.
Ck4—44 to 60 inches; dark grayish brown (10YR 4/2) fine sand, pale brown (10YR 6/3) dry; massive; loose, nonsticky and nonplastic; many fine irregular pores; strongly effervescent; disseminated lime; moderately alkaline.

These soils are always moist, and the water table fluctuates between the surface and depth of 36 inches. The particle-size control section ranges from sand to loamy fine sand. Effervescence ranges from none to violent.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 1 to 3 when moist or dry.

The C horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 1 to 3 when moist or dry. Some horizons have variegated colors when dry. Depth to basalt is 60 inches or more.

Willis Series

The Willis series consists of moderately deep, well drained soils on terraces and terrace scarps. These soils formed in loess deposited over cemented alluvium. Slopes are 2 to 30 percent.

Typical pedon of Willis silt loam, 12 to 30 percent slopes, in the NW1/4SE1/4 of sec. 22, T. 2 N., R. 28 E.

A—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; common very fine tubular pores; neutral; clear smooth boundary.
Bw—7 to 27 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium and coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; common very fine tubular pores; mildly alkaline; clear wavy boundary.
Bk—27 to 33 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; 5 percent pebbles; slightly effervescent; moderately alkaline; abrupt wavy boundary.

2Ckqm—33 to 60 inches; indurated duripan.

The particle-size control section is 10 to 15 percent clay and less than 15 percent sand that is coarser than very fine sand. The depth to the duripan ranges from 20 to 40 inches. The mollic epipedon is 7 to 18 inches thick.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry. It is silt loam or very fine sandy loam.

The Bw horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry.

The Bk horizon has value of 3 to 6 when moist and 5 to 8 when dry, and it has chroma of 1 to 4 when moist or dry.

Winchester Series

The Winchester series consists of deep, excessively drained soils on strath terraces of the Columbia River. These soils formed in eolian sand. Slopes are 0 to 5 percent.

Typical pedon of Winchester sand, 0 to 5 percent slopes, is in the NE1/4NE1/4SE1/4 of sec. 30, T. 5 N., R. 29 E.

C1—0 to 10 inches; very dark grayish brown (10YR 3/2) sand, brown (10YR 4/3) dry; single grain; loose, nonsticky and nonplastic; many very fine roots; few fine irregular pores; 5 percent pebbles 2 to 5 millimeters in diameter; neutral; gradual wavy boundary.

C2—10 to 60 inches; very dark gray (10YR 3/1) coarse sand, dark gray (10YR 4/1) dry; single grain; loose, nonsticky and nonplastic; few fine and very fine roots; few fine irregular pores; 5 percent pebbles 2 to 5 millimeters in diameter; neutral.

The particle-size control section is 75 percent or more sand that is very coarse, coarse, and medium. It has less than 5 percent clay and 0 to 15 percent rock fragments. Depth to basalt is 60 inches or more.

The C horizon has value of 3 to 7 when moist and 4 to 7 when dry, and it has chroma of 1 to 3 when moist or dry.

Winom Series

The Winom series consists of deep, moderately well drained soils in basins. These soils formed in old alluvium and lacustrine sediment. Slopes are 0 to 3 percent.

Typical pedon of a Winom silty clay loam in an area of Silvies-Winom complex, 0 to 3 percent slopes, in the SW1/4SW1/4 of sec. 15, T. 4 S., R. 31 E.

A1—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong fine and medium subangular blocky structure; hard, friable, sticky and plastic; many fine and medium roots; many very fine irregular pores; vertical cracks 2 to 5 millimeters wide; slightly acid; clear wavy boundary.

AC1—8 to 13 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; strong fine angular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; many very fine tubular pores; vertical cracks 2 to 5 millimeters wide; slightly acid; abrupt wavy boundary.

AC2—13 to 28 inches; black (10YR 2/1) clay, very dark grayish brown (10YR 3/2) dry; strong coarse columnar structure; very hard, very firm, very sticky and very plastic; few fine and medium roots; common very fine tubular pores; common slickensides; vertical cracks 5 to 15 millimeters wide; neutral; clear wavy boundary.

ACk—28 to 40 inches; black (10YR 2/1) silty clay loam, grayish brown (10YR 5/2) dry; strong medium prismatic structure parting to strong medium angular blocky; very hard, very firm, sticky and plastic; few fine and medium roots; common very fine tubular pores; common slickensides; slightly effervescent; seams of lime; moderately alkaline; clear wavy boundary.

AC—40 to 60 inches; dark yellowish brown (10YR 4/4) clay, light yellowish brown (10YR 6/4) dry; moderate medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; few fine and medium roots; common very fine tubular pores; common fine to large prominent mottles; common slickensides; neutral.

The particle-size control section is silty clay loam, silty clay, and clay and has 45 to 60 percent clay. The profile at some time in most years has open cracks at a depth of 20 inches that are at least 0.5 inch wide and extend upward to the surface. Also, between depths of 10 and 40 inches there are slickensides that are close enough to intersect. Depth to basalt or weathered volcanic tuff is 60 inches or more.

The A horizon has value of 4 or 5 when dry, and it has chroma of 0 or 1 when moist or dry.

The upper part of the AC horizon has value of 2 or 3 when moist and 3 to 5 when dry, and it has chroma of 0 or 1 when moist and 1 or 2 when dry.

The lower part of the AC horizon has value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 to 4 when moist or dry.

Wrentham Series

The Wrentham series consists of moderately deep, well drained soils on hillslopes. These soils formed in loess and colluvium. Slopes are 0 to 3 percent.

Typical pedon of a Wrentham silt loam in an area of Wrentham-Rock outcrop complex, 35 to 70 percent

slopes, in the NW1/4NE1/4SE1/4 of sec. 21, T. 1 S., R. 30 E.

A1—0 to 3 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, loose, slightly sticky and nonplastic; many very fine roots; few fine irregular pores; 5 percent pebbles; neutral; abrupt wavy boundary.
A2—3 to 10 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; 5 percent pebbles; neutral; gradual wavy boundary.
Bw1—10 to 20 inches; very dark grayish brown (10YR 3/2) gravelly silt loam, dark brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; 25 percent pebbles; mildly alkaline; gradual wavy boundary.
Bw2—20 to 33 inches; dark brown (10YR 3/3) very gravelly silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine, slightly sticky and slightly plastic; few very fine and fine roots; common very fine tubular pores; 15 percent cobbles and 35 percent pebbles; mildly alkaline; abrupt wavy boundary.
2R—33 inches; basalt.

The particle-size control section is 18 to 34 percent clay and is more than 35 percent rock fragments. The mollic epipedon is 20 to 36 inches thick. The depth to basalt ranges from 20 to 40 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry. It is 0 to 25 percent pebbles and 0 to 20 percent cobbles.

The B horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 to 4 when moist and 3 or 4 when dry. The moist value°, and it has chroma of 4 occur below a depth of 20 inches. It is silt loam or silty clay loam.

Xeric Torriorthents

The Xeric Torriorthents consists of moderately deep to deep, somewhat excessive drained to well drained soils on terrace scarps. These soils formed in eolian sands and colluvium. Slopes are 10 to 70 percent.

Reference pedon of Xeric Torriorthents in an area of Rock outcrop-Xeric Torriorthents complex, 10 to 70 percent slopes, in the SW1/4NE1/4NE1/4 of sec. 28, T. 5 N., R. 28 E.

A—0 to 10 inches; very dark grayish brown (10YR 3/2) fine sandy loam, olive brown (2.5Y 4/4) dry; weak fine granular structure and weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; many very fine roots; many fine irregular pores; 10 percent cobbles; neutral; gradual wavy boundary.
C—10 to 60 inches; very dark grayish brown (10YR 3/2) very cobbly loamy fine sand, olive brown (2.5Y 4/4) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; many fine irregular pores; 10 percent pebbles and 50 percent cobbles; neutral.

The particle-size control section ranges from coarse-loamy to sandy-skeletal. Colors are highly variable. Depth to basalt ranges from 20 inches to more than 60 inches. Rock fragment content ranges from 10 to 80 percent.

Xerofluvents

Xerofluvents consist of deep, somewhat poorly drained to excessively drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent.

Reference pedon of Xerofluvents, 0 to 3 percent slopes, in the SE1/4NE1/4SE1/4 of sec. 10, T. 2 N., R. 33 E.

A1—0 to 3 inches; very dark brown (10YR 2/2) cobbly loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 15 percent cobbles and 20 percent pebbles; neutral; clear wavy boundary.
A2—3 to 7 inches; very dark brown (10YR 2/2) very cobbly loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 20 percent cobbles and 35 percent gravel; neutral; clear wavy boundary.
AC—7 to 22 inches; very dark brown (10YR 2/2) extremely gravelly sandy loam, dark grayish brown (10YR 4/2) dry; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; 25 percent cobbles and 50 percent pebbles; neutral; clear wavy boundary.
C—22 to 60 inches; very dark grayish brown (10YR 3/2) extremely gravelly sand, grayish brown (10YR 5/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; many very fine tubular pores; 25 percent cobbles and 55 percent pebbles; neutral.

Depth to bedrock is more than 60 inches. Depth to the C horizon ranges from 20 inches to more than 60 inches.

The A horizon ranges from silt loam to loamy sand and is 10 to 50 percent rock fragments.

The C horizon ranges from silt loam to sand and is 30 to 80 percent rock fragments.

Xerollic Durorthids

The Xerollic Durorthids consist of shallow to moderately deep, well drained soils on terrace scarps. These soils formed in loess over cemented alluvium. Slopes are 30 to 60 percent.

Reference pedon of Xerollic Durorthids, 30 to 60 percent slopes, in the NE1/4SE1/4 of sec. 10, T. 2 N., R. 27 E.

A—0 to 4 inches; dark brown (10YR 3/3) cobbly very fine sandy loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; many fine irregular pores; 10 percent gravel and 10 percent cobbles on the surface; mildly alkaline; clear wavy boundary.

Bw—4 to 16 inches; dark brown (10YR 3/3) gravelly very fine sandy loam, brown (10YR 5/3) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; many fine tubular pores; 20 percent pebbles; mildly alkaline; abrupt wavy boundary.

Ckqm—16 to 60 inches; indurated duripan; strongly to weakly cemented.

The particle-size control section is 15 to 50 percent rock fragments and 15 percent or more sand that is fine or coarser. Depth to the duripan ranges from 10 to 40 inches. From 0 to 15 percent of the surface is covered with cobbles and pebbles. The particle-size control section is very fine sandy loam to loam and is 10 to 20 percent clay.

The A and B horizons have value of 3 or 4 when moist and 5 or 6 when dry, and they have chroma of 2 or 3 when moist or dry.

Yakima Series

The Yakima series consists of deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent.

Typical pedon of Yakima silt loam, 0 to 3 percent slopes (fig. 12), in the SW1/4SE1/4SW1/4 of sec. 7, T. 2 N., R. 32 E.

Ap1—0 to 2 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; neutral; clear smooth boundary.

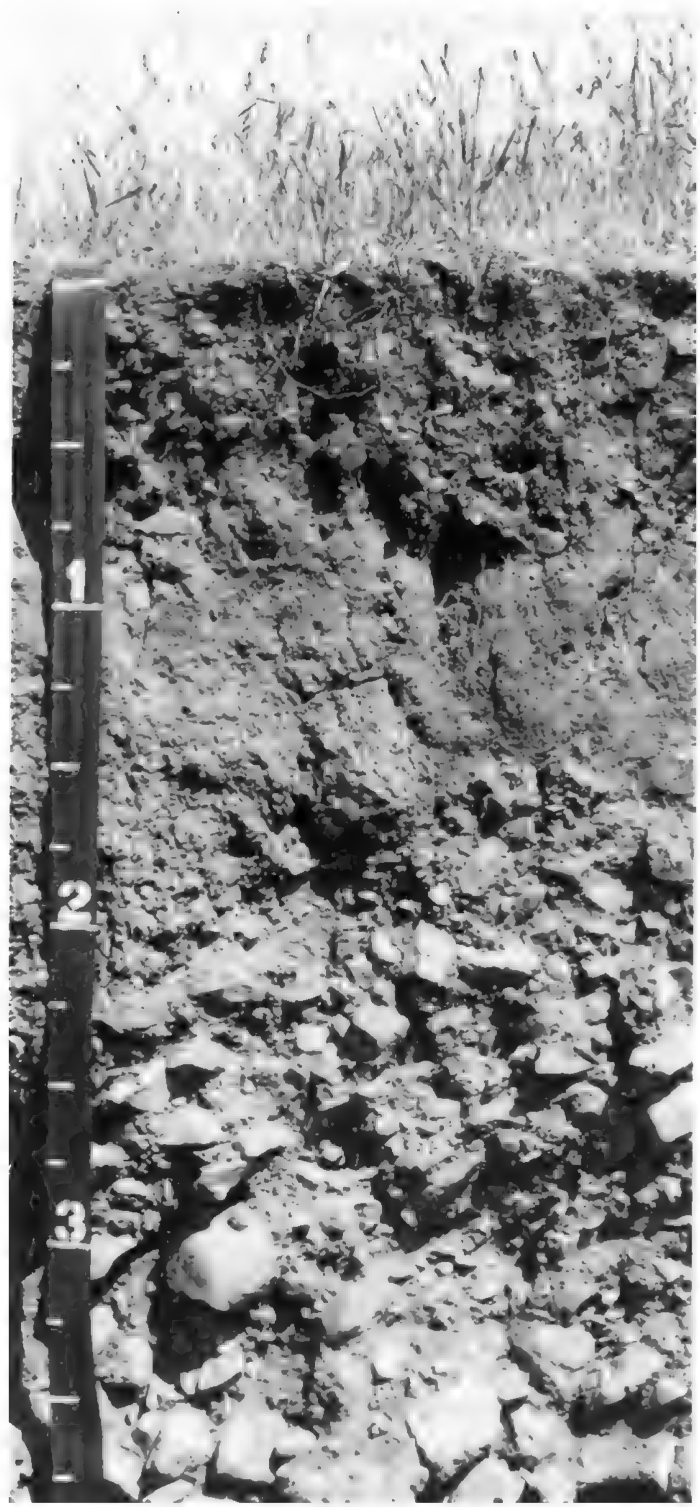


Figure 12.—Typical pedon of Yakima silt loam, 0 to 3 percent slopes, underlain by gravelly alluvium.

Ap2—2 to 10 inches; very dark brown (10YR 2/2) silt loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; neutral; clear wavy boundary.

AC—10 to 22 inches; very dark brown (10YR 2/2) silt loam, brown (10YR 4/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; neutral; gradual smooth boundary.

2C1—22 to 34 inches; very dark brown (10YR 2/2) extremely gravelly loamy sand, brown (10YR 4/3) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; 10 percent cobbles and 65 percent pebbles; neutral; gradual wavy boundary.

2C2—34 to 60 inches; very dark brown (10YR 2/2) extremely gravelly sand, brown (10YR 4/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; 15 percent cobbles and 65 percent pebbles; neutral.

The upper part of the particle-size control section is 5 to 10 percent clay and 15 percent or more sand that is coarser than very fine sand. The lower part of the control section is sand or loamy sand and averages 50 to 75 percent rock fragments. The mollic epipedon is 20 to 40 inches thick. Depth to the 2C horizon is 20 to 40 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 to 3 when moist or dry.

The 2C horizon is very gravelly or extremely gravelly sand or loamy sand.

Formation of the Soils

Soils are formed through the interaction of five major factors: Parent material, climate, living organisms, topography, and time. These factors determine physical and chemical weathering processes and the characteristics of a soil.

Parent Material

Several geological events have produced the parent material in the survey area. In the Pleistocene Epoch, floods from the Columbia River watershed deposited alluvium on what are now terraces of the Columbia Basin. Large granitic boulders that were rafted on ice in meltwater from receding glaciers now stand 500 feet above the present level of the river (fig. 13). Tremendous floods occurred as the ice dams holding back glacial Lake Missoula and Lake Bonneville broke (*4, 5, 17*). Lacustrine silt and alluvium were deposited in the lakes that were formed by debris dams along the Columbia River in such places as Wallula Gap. After the water receded, these deposits were reworked by the wind. The sandy alluvium remained within the Columbia Basin, while the lighter silt was blown over the entire Columbia Plateau (*6, 7*).

The eruption of Mount Mazama and other volcanoes deposited volcanic ash over much of the county, and there were appreciable accumulations in the Blue Mountains (*18, 19*).

Basalt flows, deposited during the Miocene Epoch, underlie most of the soils in the survey area (*27*). Materials that have weathered in place from basalt and colluvium that have moved downslope are the primary parent materials for the soils that has formed on the steep slopes of the Blue Mountains.

Alluvium was deposited on fans along the shoreline of Condon Lake after the Pliocene uplift of the Blue Mountains (*12, 13*). Much of this alluvium has since been cemented with silica and calcium carbonate and is mantled by more recent loess deposits. These cemented layers occur as erosional remnants on high knolls and as nearly level terraces throughout the Columbia Basin and Columbia Plateau.

Tuffaceous alluvial material was deposited on terraces of the early Pliestocene lake in the Ukiah Valley of the Blue Mountains. Granodiorite and metasediment were uplifted around the Carney Butte area. The soils in these areas developed primarily from these parent materials.

Climate

The climate in the survey area is diverse, and it is assumed to have varied even more during the Pleistocene, in which time many of the soils formed. The arid western part of the survey area receives only 8 inches of rainfall and has a growing season of about 190 days. In such an arid climate, the soils exhibit little development.

More that 50 inches of rainfall is received at the higher elevations of the Blue Mountains, and the growing season is as short as 30 days. Many soils within the survey area differ in characteristics primarily as a result of climate. Within the Columbia Plateau province, the Shano, Ritzville, Walla Walla, Athena, and Palouse soils form a climosequence. These soils formed in loess and differ in organic matter content, structural development, and base saturation (fig. 14).

Living Organisms

Living organisms, especially higher plants, are active in soil formation. Vegetation increases in density with increasing precipitation and greater available moisture in the deeper soils that have finer texture. Decaying vegetation supplies the soil with organic matter, which increases the available water capacity, water intake rate, fertility, and tilth. Soils that are high in content of organic matter generally have a darker surface layer than those that are low. The droughty, sandy soils in the arid Columbia Basin have less than 1 percent organic matter in the surface layer, whereas the very dark brown loess soils on the foothills of the Blue Mountains have as much as 5 percent. The type of vegetation also depends upon aspect. Soils on northern exposures of hillslopes generally have more dense vegetation than those on the droughty southern exposures.

Topography

Aspect also determines the depth of the soils on hillslopes. Soils that have north- and east-facing slopes and are in the lee of landforms that block the prevailing winds are deep, whereas steep soils that have south-

Figure 13.—An ice-rafted granite boulder that was left after the floodwaters of Lake Missoula receded.

facing slopes generally are shallow and have a small amount of loess.

Relative location to the prevailing winds within the survey area also determines soil depth. The deep loess soils to the north of Pendleton are within the southwesterly prevailing wind vector. Soils to the south of this vector are moderately deep and shallow (fig. 15).

Each of the major landforms within the survey area provides differing parent materials. The alluvial terraces and fans are mantled by loess and reworked by wind. Hill summits and hillslopes are covered by variable amounts of loess, residuum, and colluvium, depending upon slope and aspect. Mountain plateaus generally contain materials that weathered from bedrock and have surficial volcanic ash deposits.

Time

The length of time a soil is in place is directly related to the development of the horizons in that soil. If the sandy soils of the Columbia Basin are not vegetated, they turn into dunal areas. These soils have not developed a B horizon and have only a thin A horizon as a result of soil blowing. The finer textured sands have developed a B horizon because they have been disturbed less by soil blowing.

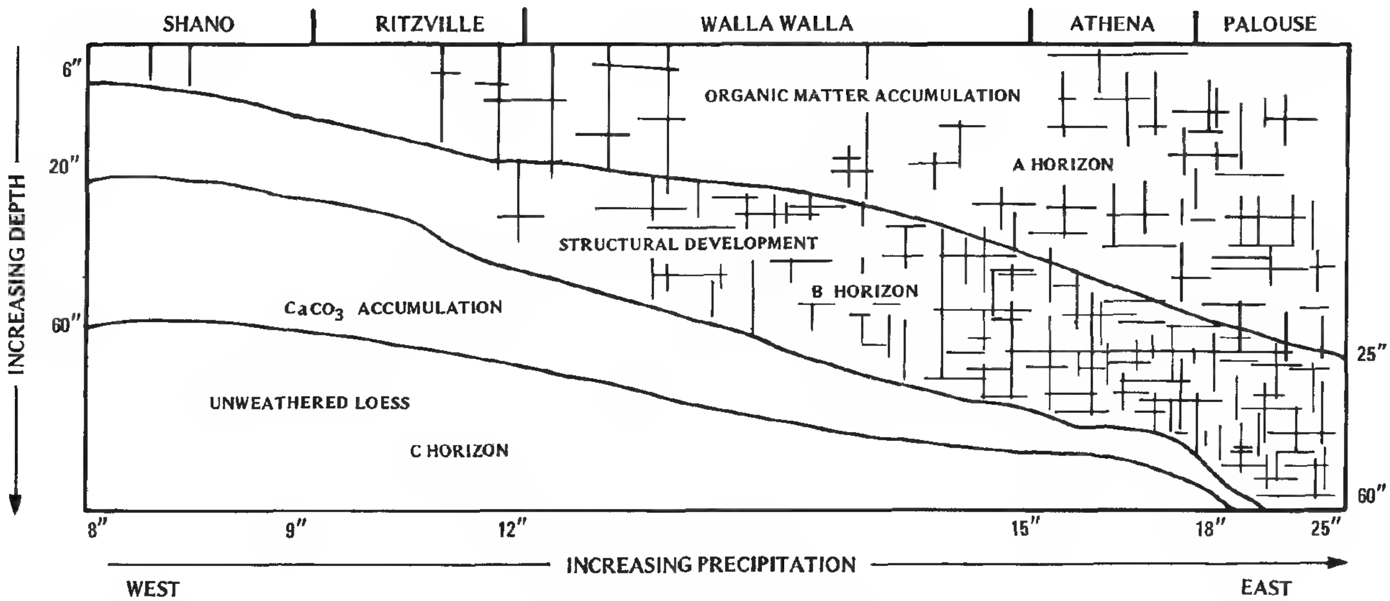


Figure 14.—Climosequence of the deep loess area.

In the following paragraphs the effects of time on the development of the soils is discussed by the major land resource areas in the survey area.

Columbia Basin.—In the Columbia Basin, the soils exhibit little evidence of development because of their sandy texture, their susceptibility to soil blowing, and the short period of time that the soils have been in place. The arid climate also inhibits physical and chemical weathering of the parent material. The predominant soil orders in the Columbia Basin are Entisols and Aridisols.

The coarser textured sandy soils are Xeric Torripsamments. Winchester sands have only a C horizon and are highly susceptible to soil blowing. An A horizon has developed in the Quincy fine sands and loamy fine sands. The Burbank loamy fine sands have a high content of rock fragments and are Xeric Torriorthents. The finer sandy loams are Xerollic Camborthids. The Adkins fine sandy loams are Xerollic Camborthids. There soils are least susceptible to soil blowing, and they have an A and B horizon. The Starbuck very fine sandy loams are Lithic Xerollic Camborthids. The shallow Starbuck soils are in channel and scabland areas along the Columbia River.

Columbia Plateau.—The Columbia Plateau is south and east of the Columbia Basin and adjoins the foothills of the Blue Mountains. Basalt and old alluvial deposits in this area have been mantled by loess blown from Pleistocene alluvial deposits. The loess is of granitic and metamorphic origin and therefore was not derived from the basalt of the Columbia Basin and Plateau (*15, 16*).

The Columbia Plateau is dominated by Mollisols in which the organic matter content increases as vegetation density and precipitation increase. The plateau can be roughly divided into four smaller regions in which the soil forming factors differ. The regions in the prevailing wind vectors have the deepest loess deposits.

The largest of these regions is the highly productive nonirrigated wheat-growing region north of Pendleton. A climosequence occurs in these deep loess soils. As the rainfall increases to the east, the color of the epipedon becomes darker because of the greater addition of decayed plant material, carbonates have been leached deeper in the profile, and the soil structure is stronger. This classic climosequence is Xerollic Camborthids (for example, Shano soils), Calciorthidic Haploxerolls (for example, Ritzville soils), and Typic Haploxerolls (for example, Walla Walla soils). The Athena and Palouse soils continue the sequence eastward, although they are in the foothills of the Blue Mountains. The Athena soils are Pachic Haploxerolls, and the Palouse soils are Pachic Ultic Haploxerolls. The Palouse soils have the greatest accumulation of organic matter, the lowest base saturation, and the strongest structural development in the sequence.

A second region is composed of the McKay Beds, south of Pendleton. These beds have been mantled by loess and consist of gravelly alluvium deposited during the Pliocene uplifting of the Blue Mountains in what was Condon Lake (*12, 13*). The moderately deep Pilot Rock soils (Haplic Durixerolls) are on fan terraces and have a

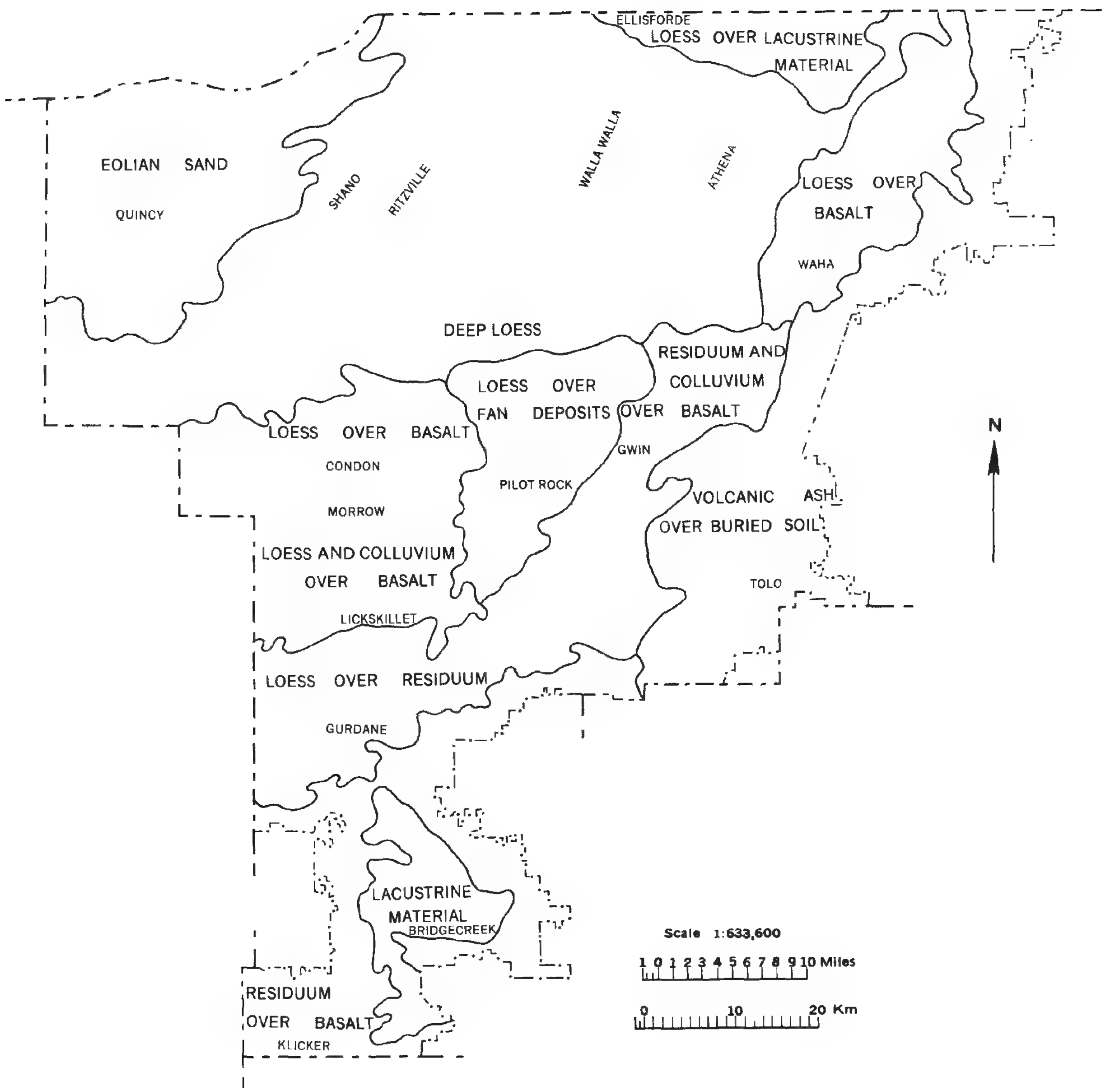


Figure 15.—Parent material and major soils of the survey area.

loess mantle over cemented gravelly alluvium. The deep McKay soils (Calcic Argixerolls) are on coalescent fan piedmonts of the Blue Mountains (fig. 16).

A third region is located north and west of the Milton-Freewater area. The lacustrine silt of the Touchet Beds was deposited in the lake formed by hydraulic damming

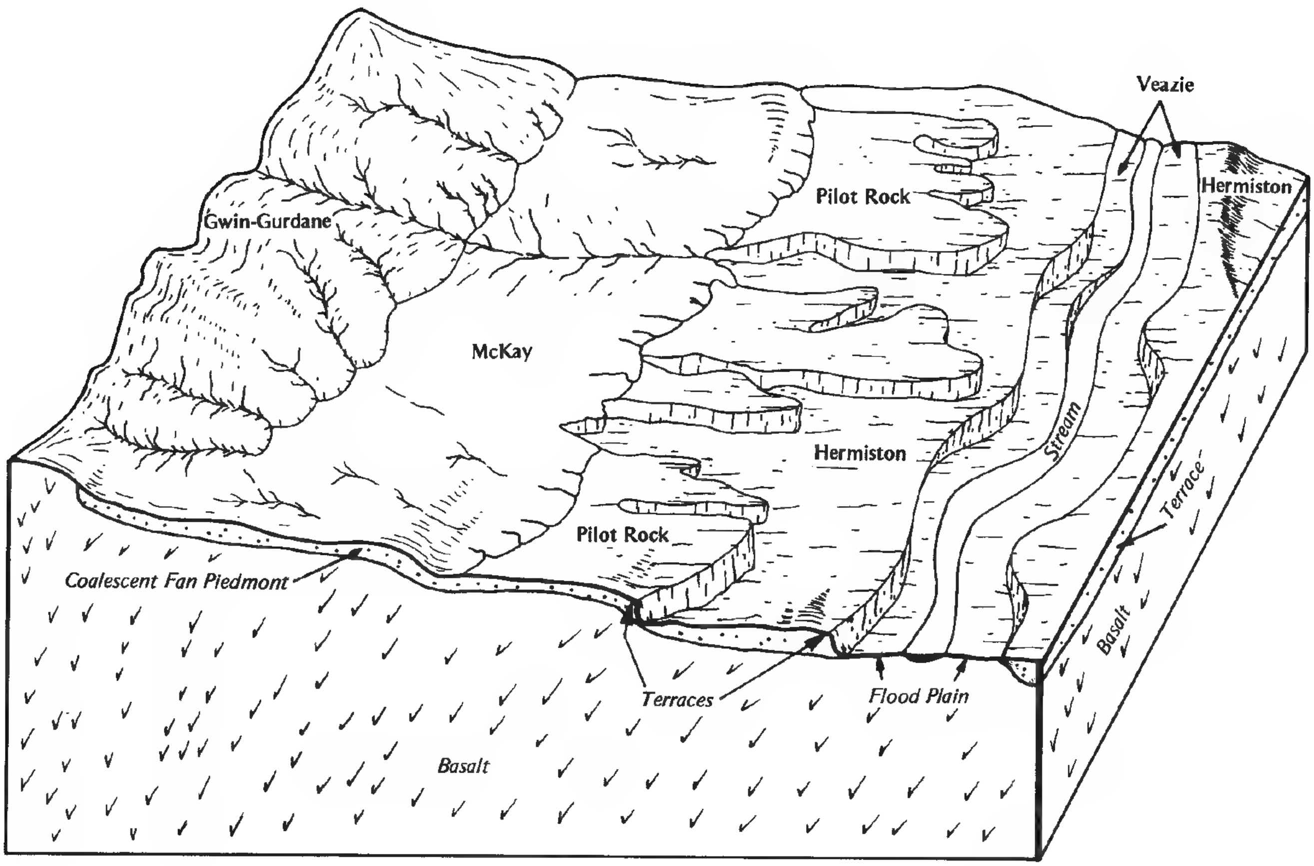


Figure 16.—Soil-landform patterns in the area south of Pendleton.

at Wallula Gap during the late Pleistocene Spokane floods (*15*). Lacustrine material occurs as terraces throughout the Walla Walla Valley. The Ellisforde soils (Calciorthidic Haploxerolls) have a loess mantle over stratified lacustrine silt and fine sand. The Oliphant soils (Calcic Haploxerolls) are in an area of higher rainfall and have a thicker mantle of loess over lacustrine material.

The fourth region, southwest of Pendleton, consists predominantly of moderately deep and shallow, finer textured soils. Being south of the prevailing wind vector, the loess is thin and aspect has had a great affect on soil depth. Shallow soils such as those of the Lickskillet series (Lithic Haploxerolls) are in steep south-facing areas. The moderately deep Condon soils (Typic Haploxerolls) formed in a loess mantle over basalt. The Morrow soils (Calcic Argixerolls) are moderately deep and are in an area of higher precipitation than are the Condon soils. They formed from loess and material weathered from Pliocene alluvium overlying basalt.

Pleistocene frost action on the nearly level ridges has produced periglacial patterned ground. Condon and Morrow soils occur in complexes with the very shallow Bakeoven soils in biscuit-scabland areas on the Columbia Plateau. Waha and Gurdane soils occur in complexes with the very shallow Rockly soils on ridges in the foothills of the Blue Mountains.

Foothills of the Blue Mountains.—Generally, the soils on the foothills of the Blue Mountains have more organic matter and translocated clay, exhibit lower base saturation, and are structurally more developed than the soils on the Columbia Plateau. They are primarily Pachic Argixerolls and Pachic Haploxerolls.

The soils north of the Umatilla River generally have thick loess deposits because of the prevailing wind vector. Aspect and slope determine the depth of the soils in this area. The moderately deep Waha soils (Pachic Argixerolls) are in moderately sloping areas. The deep Palouse soils (Pachic Ultic Haploxerolls) are on steep north aspects. The shallow Gwin soils (Lithic

Argixerolls) are on steep south aspects throughout this area.

The southern part of the foothill area has very thin loess deposits, and thus the soils are influenced less by aspect. The Gurdane soils (Pachic Argixerolls) are in moderately sloping areas as well as on steep north aspects. They have a higher content of rock fragments and residual clay than the Waha soils to the north. The shallow Gwin soils occur in complexes with the moderately deep Gurdane soils on steep east and west aspects. The Gwin soils are also on very steep south aspects.

Blue Mountains.—The Blue Mountains have been greatly affected by volcanic ash from the eruption of Mount Mazama about 6,600 years ago (*18, 19*). The prevailing winds carried tephra hundreds of miles and deposited it over eastern Oregon. Gusty winds blew the ash from sparsely vegetated rangeland and forested soils. The ash then accumulated in the densely forested areas on gently sloping leeward slopes and was washed into depressional areas.

The Tolo soils (Typic Vitrandepts) are on plateaus and are densely forested with lodgepole pine, western larch, and grand fir. These soils have 20 to 40 inches of volcanic ash over a buried paleosol.

The very steep, forested, north-facing slopes of the Blue Mountains have little volcanic ash. The ash originally deposited on these leeward slopes has since been eroded. The deep Umatilla and Kahler soils (Pachic Ultic Haploxerolls) formed in loess and in colluvial and residual materials. These soils support dense stands of Douglas-fir. The Umatilla soils are skeletal.

Most of the survey area is underlain by Miocene Columbia River Basalt that flowed from faults throughout eastern Oregon and Washington. These flows eventually produced a plateau that was faulted and uplifted during the Pliocene and has since been eroded (*28*). Remnants of this ancient plateau occur throughout the Blue Mountains.

Sparsely forested soils, such as those of the Klicker series, and grassland soils, such as those of the Anatone and Bocker series, have not been greatly influenced by the windblown ash or loess. These soils formed mainly in material weathered from basalt and colluvium.

The Klicker soils (Ultic Argixerolls) are moderately deep and skeletal. Scattered ponderosa pine is common on these soils. The Bocker very cobbly silt loams (Lithic Haploxerolls) are very shallow and occur in complex with the forested Klicker soils and the shallow Anatone soils (Lithic Haploxerolls). The Gwin soils (Lithic Argixerolls) are on very steep south exposures.

The Cowsly soils (Xeric Argialbolls) are on remnants of the Miocene basalt plateau and have a perched water table early in spring. A very light colored albic horizon has formed in these soils because of the eluviation of clay, iron oxide, and organic matter.

In the Ukiah Valley, in the open grassland areas, soils have weathered from tuffaceous sediment. The moderately deep Bridgecreek soils (Typic Palexerolls) have a clayey subsoil that formed in pyroclastic flows that have been reworked by water (*20*).

Around Carney Butte the parent material consists of weathered granitic and metamorphic rocks. This area is composed of uplifted granodiorite of late Jurassic age and metasediment of Permian or Triassic age (*22, 23*). Mazama ash and loess were deposited over the soils derived from granitic and metamorphic rocks.

Flood Plains.—Umatilla County is drained by the Umatilla, North Fork of the John Day, and Walla Walla Rivers. The soils on the flood plains and terraces of these rivers and their tributaries formed in alluvium. Stream terraces are former flood plains that are now abandoned.

The lowest geomorphic surface is the annual flood plain. The soils on this surface range from barren riverwash to vegetated sandy and gravelly alluvium. These soils have had little time to develop because of the continual reworking of the alluvial deposits by floodwater. Xerofluvents occur along the Umatilla and Walla Walla Rivers. These soils formed in a mixture of alluvium and are somewhat poorly drained to excessively drained.

The soils of the next higher flood plain also formed in mixed alluvium. Most areas are now protected by levees and are rarely flooded. The very cobbly Freewater soils (Fluventic Haploxerolls) are on this surface. These soils are somewhat excessively drained because of the high content of sand, gravel, and cobbles.

Silty alluvium has been deposited on the highest flood plain, which is rarely flooded. The Hermiston soils (Cumulic Haploxerolls) are deep and well drained. They have a thick surface accumulation of silt that is high in organic matter content and a horizon of secondary calcium carbonate accumulation. The Pedigo soils (Cumulic Haploxerolls) are in depressional areas and have a seasonal high water table and a high content of sodium.

References

(1) Alexander, R.R. 1967. Site indexes for Engelmann spruce in the central Rocky Mountains. U.S. Dep. Agric., Forest Serv., Rocky Mt. Forest and Range Exp. Stn. Res. Pap. RM-32, 7 pp., illus.

(2) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vol., illus.

(3) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(4) Baker, V.R. and D. Nunmedal. 1978. The Channeled Scabland. Planetary Geology Program, Office of Space Science. NASA, Washington, D.C., 186 pp., illus.

(5) Bretz, J.H. 1969. The Lake Missoula floods and the Channeled Scabland. J. Geol., Vol. 77, pp. 505-543, illus.

(6) Bryan, K. 1926. The "Palouse soil" problem. U.S. Geol. Surv. Bull. 790-B, 97 pp., illus.

(7) Calkins, F.C. 1905. Geology and water resources of a portion of east-central Washington. U.S. Geol. Surv. Water Supply Pap. 118, 46 pp., illus.

(8) Cochran, P.H. 1979. Gross yields for even-aged stands of Douglas-fir and white or grand fir east of the Cascades in Oregon and Washington. U.S. Dep. Agric., Forest Serv., Pacific Northwest Forest and Range Exp. Stn. Res. Pap. PNW-263, 17 pp., illus.

(9) Cochran, P.H. 1979. Site index and height growth curves for managed, even-aged stands of Douglas-fir east of the Cascades in Oregon and Washington. U.S. Dep. Agric., Forest Serv., Pacific Northwest Forest and Range Exp. Stn. Res. Pap. PNW-251, 16 pp., illus.

(10) Cochran, P.H. 1979. Site index and height growth curves for managed, even-aged stands of white or grand fir east of the Cascades in Oregon and Washington. U.S. Dep. Agric., Forest Serv., Pacific Northwest Forest and Range Exp. Stn. Res. Pap. PNW-252, 13 pp., illus.

(11) East Central Oregon Association of Counties. 1979. Umatilla County economic statement. Sections A, F, G, H. 242 pp., illus.

(12) Hodge, E.T. 1942. Geology of north central Oregon. Corvallis, Monograph, Studies in Geol., No. 3, 76 pp.

(13) Hogenson, G.M. 1964. Geology and ground water of the Umatilla River Basin, Oregon. U.S. Geol. Surv. Water Supply. Pap. 1620, 162 pp., illus.

(14) Meyer, Walter H. 1938. Yield of even-aged stands of ponderosa pine. U.S. Dep. Agric. Tech. Bull. No. 630, 59 pp., illus.

(15) Newcomb, R.B. 1965. Geology and ground water resources of the Walla Walla River Basin, Washington-Oregon. WA Div. Water Res. Water Supply Bull. 21, 151 pp., illus.

(16) Newcomb, R.B. 1969. Geology of the Deschutes-Umatilla Plateau, in Weissenborn, A.E. Ed. Mineral and water resources of Oregon. OR Dep. Geol. and Min. Ind. Bull. 64, pp. 60-66, illus.

(17) Parsons, R.B., C.J. Weisel, G.H. Logan, and W.D. Nettleton. 1981. The soil sequence of later Pleistocene glacial outwash terraces from Spokane floods in the Idaho Panhandle. Soil Sci. Soc. Amer. J. 45, pp. 925-930, illus.

(18) Rai, D. (n.d.) Stratigraphy and genesis of soils from volcanic ash in the Blue Mountains of eastern Oregon. Ph.D. thesis. OR State Univ., Corvallis, OR, 136 pp., illus.

(19) Richmond, G.N., R. Fryxell, G.E. Neff, and P.L. Weis. 1965. The Cordilleran ice sheet of the northern Rocky Mountains and related quaternary history of the Columbia Plateau. *In* The Quaternary of the United States. Princeton Univ., Princeton, NJ, pp. 231-242.

(20) Shotwell, J.R. 1956. Hemphillian mammalian assemblage from northeastern Oregon. Geol. Soc. Am. Bull., Vol. 67, No. 6, pp. 717-738, illus.

(21) State Water Resources Board. 1963. Umatilla River Basin. 107 pp., illus.

(22) Taubeneck, W.H. 1955. Age of the Bald Mountain batholith, northeastern Oregon. Northwest Sci., Vol. 29, No. 3, pp. 93-96, illus.

(23) Taubeneck, W.H. 1957. Geology of the Elkhorn Mountains, northeastern Oregon-Bald Mountain batholith. Geol. Soc. Am. Bull., Vol. 68, No. 2, pp. 181-283, illus.

(24) United States Department of Agriculture. 1948. Soil Survey of the Umatilla County Area, Oregon. Agric. Res. Admin., Bur. Plant Ind., Soils, and Agric. Eng., 120 pp., illus.

(25) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Supplements replacing pp. 173-188 issued May 1962)

(26) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(27) Waters, A.C. 1950. Multiple feeders of the Columbia River Basalt. Geol. Soc. Am. Bull. 61: 1,533.

(28) Waters, A.C. 1961. Stratigraphic and lithographic variations in the Columbia River Basalt. Am. J. Sci. 256: 583-611.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal-unit-month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Bajada. A broad alluvial slope extending from the base of a mountain range out into a basin and formed by coalescence of separate alluvial fans.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Biscuit-scabland. Patterned ground that has mounds (biscuits) of moderately deep soils in complex with shallow and very shallow soils. It commonly is in an area affected by periglacial or congeliturbate processes.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breast height. An average height of 4 1/2 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management. Use of mechanical, chemical, or biological methods to reduce or eliminate competition of woody vegetation to allow understory grasses and forbs to recover, or to make conditions favorable for reseeding. It increases production of forage, which reduces erosion. Brush management may improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Cable yarding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a

drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Chemical treatment. Control of unwanted vegetation by use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter, in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay skin. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay film.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climosequence. A sequence of related soils that differ from each other in certain properties primarily as a result of the effect of climate as a soil-forming factor.

Coarse fragments. Mineral or rock particles larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conglomerate. A coarse grained, clastic rock composed of rounded to subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. If soil improving crops and practices used in the system more than offset the soil depleting crops and deteriorating practices, then it is a good conservation cropping system. Cropping systems are needed on all tilled soils. Soil improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops using a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Delta. A body of alluvium whose surface is nearly flat and fan shaped, deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Desert pavement. A layer of gravel or coarser fragments on a desert soil surface that was emplaced by upward movement of fragments from underlying sediment or remains after finer particles have been removed by running water or wind.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—These soils have very high and high hydraulic conductivity and low water holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained.—These soils have high hydraulic conductivity and low water holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.—These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.—These soils are wet to the surface most of the time. They are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

Drainage, surface. Runoff, or surface flow of water, from an area.

Duff. A term used to identify a generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. Synonym: scarp.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, and clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of men and equipment in fire fighting. Designated roads also serve as firebreaks.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (or 300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard rock. Rock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

High-residue crops. Crops such as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well-defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate;

the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	Very low
0.2 to 0.4	Low
0.4 to 0.75	Moderately low
0.75 to 1.25	Moderate
1.25 to 1.75	Moderately high
1.75 to 2.5	High
More than 2.5	Very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Center pivot.—An automatically rotating sprinkler pipe, or boom, that supplies water to the sprinkler heads, or nozzles, from the center, or pivot point, of the system.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Hand line.—A sprinkler system in which the pipes containing the sprinkler heads are carried by hand to each new setting.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wheel line.—A sprinkler system in which the pipes containing the sprinkler heads are supported on wheels and are rolled to each new setting.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Crops such as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color in hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Patterned ground. A term for the more or less symmetrical forms such as circles, polygons, nets, stripes, garlands, and steps that are characteristic of, but not confined to, mantles that have been subjected to intense frost action, as in periglacial environments.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	Less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	More than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting (in tables). Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential native plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed. (See climax plant community.)

Prescribed burning. The application of fire to land under such conditions of weather, soil moisture, and time of day as presumably will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This increases the vigor and reproduction of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or

browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site class. A grouping of site indexes into 5 to 7 production capability levels. Each level can be represented by a site curve.

Site curve (50-year). A set of related curves on a graph that shows the average height of dominant trees for the range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant trees that are 50 years old or are 50 years old at breast height.

Site curve (100-year). A set of related curves on a graph that show the average height of dominant and

codominant trees for a range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant and codominant trees that are 100 years old or are 100 years old at breast height.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Skid trail. Trail or furrow made by a log or logs skidded over the surface of the ground.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Soft rock. Rock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil blowing. The hazard of soil blowing is related to the wind erodibility of the surface layer. Fine to coarse sand is most susceptible to blowing.

Soil pubbling. Compaction of a soil when moist to the state where the soil particles are rearranged to a massive or structureless state.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every

year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Tail water. The water just downstream of a structure.

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Terrace scarp. The steeper descending slope (more than 15 percent) of a terrace. It is cut or eroded by stream action.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Volcanic ash. The finer textured particles of material ejected from a vent during an eruption and transported through the air.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Windthrow. The action of uprooting and tipping over trees by the wind.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-81 at Hermiston, OR]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	40.0	24.4	32.2	63	-9	109	1.35	0.64	1.96	5	5.2
February---	48.3	29.5	38.9	67	7	85	0.83	0.31	1.25	4	1.1
March------	56.7	32.7	44.7	74	16	163	0.70	0.34	1.00	3	0.6
April------	64.8	38.4	51.6	84	22	348	0.60	0.14	0.96	2	0.0
May--------	73.7	45.8	59.8	95	31	614	0.71	0.21	1.11	2	0.0
June-------	81.5	53.0	67.3	100	40	819	0.51	0.15	0.79	2	0.0
July-------	89.6	57.7	73.7	106	43	1,045	0.20	---	0.35	1	0.0
August-----	87.6	56.3	72.0	104	42	992	0.38	---	0.63	1	0.0
September--	79.4	47.9	63.7	97	33	711	0.39	0.06	0.65	1	0.0
October----	66.2	37.9	52.1	85	21	375	0.71	0.18	1.12	2	0.0
November---	50.3	31.1	40.7	70	12	119	1.19	0.55	1.73	5	1.6
December---	42.8	27.3	35.1	64	4	46	1.38	0.69	1.97	6	2.7
Yearly:											
Average--	65.1	40.2	52.7	---	---	---	---	---	---	---	---
Extreme--	---	---	---	107	-13	---	---	---	---	---	---
Total----	---	---	---	---	---	5,426	8.95	7.19	10.62	34	11.2

See footnote at end of table.

TABLE 1.--TEMPERATURE AND PRECIPITATION--Continued

[Recorded in the period 1951-75 at Meacham, OR]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	32.5	21.4	27.0	50	-8	15	4.80	2.57	6.75	13	31.0
February---	37.3	24.7	31.0	54	4	19	3.26	2.18	4.24	10	23.4
March------	40.4	25.7	33.1	60	8	16	3.08	1.97	4.07	10	23.6
April------	47.4	30.2	38.8	72	19	83	2.83	1.65	3.88	9	14.1
May--------	57.3	37.6	47.5	83	24	254	2.28	1.36	3.09	7	3.6
June-------	65.7	44.0	54.9	87	31	447	1.85	0.91	2.65	6	0.7
July-------	76.9	50.8	63.9	95	37	741	0.52	0.05	0.87	1	0.0
August-----	74.9	50.1	62.5	95	36	698	0.96	0.06	1.60	3	0.0
September--	66.7	44.1	55.4	90	28	470	1.49	0.40	2.36	4	0.6
October----	54.9	36.7	45.8	79	21	223	2.48	1.06	3.68	7	5.0
November---	40.8	28.5	34.7	62	8	26	4.19	2.28	5.87	11	16.9
December---	34.0	23.8	28.9	51	-2	9	4.99	2.96	6.79	12	27.4
Yearly:											
Average--	52.4	34.8	43.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	97	-15	---	---	---	---	---	---
Total----	---	---	---	---	---	3,001	32.73	28.26	37.01	93	146.3

See footnote at end of table.

TABLE 1.--TEMPERATURE AND PRECIPITATION--Continued

[Recorded in the period 1951-81 at Pendleton, OR]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	39.4	26.5	33.0	64	-9	125	1.70	0.82	2.46	6	7.4
February---	46.9	31.8	39.4	66	10	88	1.12	0.53	1.62	4	2.5
March------	53.4	34.5	44.0	73	20	149	1.07	0.59	1.49	5	1.3
April------	61.4	39.2	50.3	83	27	313	0.99	0.30	1.55	4	0.2
May--------	70.5	46.1	58.3	92	33	567	1.10	0.36	1.70	4	0.0
June-------	79.3	52.8	66.1	98	41	783	0.72	0.30	1.07	3	0.0
July-------	88.7	58.4	73.6	105	45	1,042	0.32	0.02	0.54	1	0.0
August-----	86.0	57.5	71.8	103	45	986	0.53	---	0.90	2	0.0
September--	77.1	50.5	63.8	97	36	714	0.61	0.19	0.95	2	0.0
October----	63.6	41.3	52.5	84	26	388	0.95	0.34	1.45	3	0.3
November---	48.9	33.4	41.2	71	15	134	1.50	0.69	2.18	5	2.3
December---	42.5	29.5	36.0	64	4	65	1.68	0.81	2.42	7	4.0
Yearly:											
Average--	63.1	41.8	52.5	---	---	---	---	---	---	---	---
Extreme--	---	---	---	106	-12	---	---	---	---	---	---
Total----	---	---	---	---	---	5,354	12.29	10.34	14.17	46	18.0

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for range vegetation in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
[Recorded in the period 1951-81 at Hermiston, OR]			
Last freezing temperature in spring:			
1 year in 10 later than--	April 19	April 26	May 12
2 years in 10 later than--	April 11	April 21	May 6
5 years in 10 later than--	March 27	April 10	April 25
First freezing temperature in fall:			
1 year in 10 earlier than--	October 14	October 3	September 23
2 years in 10 earlier than--	October 22	October 9	September 28
5 years in 10 earlier than--	November 7	October 19	October 8
[Recorded in the period 1951-75 at Meacham, OR]			
Last freezing temperature in spring:			
1 year in 10 later than--	May 4	May 23	June 13
2 years in 10 later than--	April 28	May 19	June 7
5 years in 10 later than--	April 17	May 10	May 26
First freezing temperature in fall:			
1 year in 10 earlier than--	October 12	September 22	August 29
2 years in 10 earlier than--	October 19	September 29	September 8
5 years in 10 earlier than--	November 1	October 13	September 26

TABLE 2.--FREEZE DATES IN SPRING AND FALL--Continued

[Recorded in the period 1951-81 at Pendleton, OR]

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 29	April 18	May 3
2 years in 10 later than--	March 19	April 8	April 26
5 years in 10 later than--	February 28	March 19	April 13
First freezing temperature in fall:			
1 year in 10 earlier than--	October 24	October 14	September 24
2 years in 10 earlier than--	November 5	October 25	October 5
5 years in 10 earlier than--	November 28	November 15	October 28

TABLE 3.--GROWING SEASON

Probability	Length of growing season if daily minimum temperature exceeds--		
	24 °F	28 °F	32 °F
[Recorded in the period 1951-81 at Hermiston, OR]			
	Days	Days	Days
9 years in 10	195	168	142
8 years in 10	205	176	150
5 years in 10	224	191	165
2 years in 10	243	206	179
1 year in 10	253	214	187
[Recorded in the period 1951-75 at Meacham, OR]			
	Days	Days	Days
9 years in 10	170	133	86
8 years in 10	179	140	98
5 years in 10	197	155	122
2 years in 10	215	170	145
1 year in 10	224	177	157
[Recorded in the period 1951-81 at Pendleton, OR]			
	Days	Days	Days
9 years in 10	234	203	165
8 years in 10	246	214	174
5 years in 10	269	236	191
2 years in 10	294	260	210
1 year in 10	314	278	225

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1B	Adkins fine sandy loam, 0 to 5 percent slopes	22,860	1.5
1C	Adkins fine sandy loam, 5 to 25 percent slopes	3,415	0.2
2B	Adkins fine sandy loam, gravelly substratum, 0 to 5 percent slopes	2,485	0.2
2C	Adkins fine sandy loam, gravelly substratum, 5 to 25 percent slopes	895	0.1
3A	Adkins fine sandy loam, wet, 0 to 3 percent slopes	4,310	0.3
3C	Adkins fine sandy loam, wet, 3 to 15 percent slopes	860	0.1
4B	Adkins-Urban land complex, 0 to 5 percent slopes	1,020	0.1
5C	Albee-Bocker-Anatone complex, 2 to 15 percent slopes	31,910	1.9
6B	Anderly silt loam, 1 to 7 percent slopes	815	0.1
6C	Anderly silt loam, 7 to 12 percent slopes	5,230	0.3
6D	Anderly silt loam, 12 to 20 percent slopes	3,715	0.2
6E	Anderly silt loam, 20 to 35 percent slopes	1,075	0.1
7C	Anderly-Urban land complex, 7 to 12 percent slopes	595	*
8B	Athena silt loam, 1 to 7 percent slopes	45,110	2.7
8C	Athena silt loam, 7 to 12 percent slopes	9,775	0.6
9C	Bocker very cobbly silt loam, 2 to 12 percent slopes	1,685	0.1
10D	Bocker-Bridgecreek complex, 1 to 15 percent slopes	10,255	0.6
11F	Bowlus-Buckcreek association, 40 to 70 percent slopes	12,085	0.7
12C	Bridgecreek silt loam, 1 to 12 percent slopes	16,505	1.0
12E	Bridgecreek silt loam, 12 to 35 percent slopes	915	0.1
13F	Buckcreek-Gwin association, 45 to 70 percent slopes	29,170	1.8
14B	Burbank loamy fine sand, 0 to 5 percent slopes	8,465	0.5
15B	Burke silt loam, 1 to 7 percent slopes	15,160	0.9
15C	Burke silt loam, 7 to 12 percent slopes	3,530	0.2
15E	Burke silt loam, 12 to 30 percent slopes	1,990	0.1
16B	Cantala silt loam, 1 to 7 percent slopes	280	*
16C	Cantala silt loam, 7 to 12 percent slopes	955	0.1
16D	Cantala silt loam, 12 to 20 percent slopes	3,225	0.2
16E	Cantala silt loam, 20 to 35 percent slopes	2,160	0.1
17A	Catherine Variant-Catherine silt loams, 0 to 3 percent slopes	815	0.1
18B	Condon silt loam, 1 to 7 percent slopes	13,970	0.8
18C	Condon silt loam, 7 to 12 percent slopes	15,695	0.9
18E	Condon silt loam, 20 to 35 percent slopes	1,450	0.1
19D	Condon silt loam, 12 to 20 percent north slopes	7,280	0.4
20D	Condon silt loam, 12 to 20 percent south slopes	2,215	0.1
21D	Condon-Bakeoven complex, 2 to 20 percent slopes	11,805	0.7
22C	Cowsly silt loam, 2 to 12 percent slopes	10,275	0.6
22D	Cowsly silt loam, 12 to 20 percent slopes	2,435	0.1
23	Dune land	1,345	0.1
24B	Ellisforde silt loam, 1 to 7 percent slopes	6,445	0.4
24C	Ellisforde silt loam, 7 to 20 percent slopes	1,440	0.1
25C	Ellisforde-Ellisforde, eroded complex, 1 to 20 percent slopes	2,600	0.2
26E	Entic Durochrepts, 20 to 40 percent slopes	1,280	0.1
27A	Esquatzel silt loam, 0 to 3 percent slopes	2,350	0.1
28A	Freewater gravelly silt loam, 0 to 3 percent slopes	3,045	0.2
29A	Freewater very cobbly loam, 0 to 3 percent slopes	3,675	0.2
30A	Freewater-Urban land complex, 0 to 3 percent slopes	1,070	0.1
31B	Gurdane silty clay loam, 0 to 7 percent slopes	10,610	0.6
31D	Gurdane silty clay loam, 7 to 25 percent slopes	10,315	0.6
31E	Gurdane silty clay loam, 25 to 45 percent slopes	8,870	0.5
32E	Gurdane-Gwinly association, 20 to 40 percent slopes	23,175	1.4
33D	Gurdane-Rockly complex, 2 to 20 percent slopes	30,745	1.9
34F	Gwin-Klicker-Rock outcrop complex, 30 to 70 percent slopes	17,530	1.1
35F	Gwin-Rock outcrop complex, 40 to 70 percent slopes	94,280	5.7
36E	Gwinly very cobbly silt loam, 7 to 40 percent slopes	21,715	1.3
37C	Hankins silt loam, 2 to 15 percent slopes	8,040	0.5
37E	Hankins silt loam, 15 to 35 percent slopes	2,225	0.1
38C	Helter silt loam, 2 to 15 percent slopes	3,695	0.2
38E	Helter silt loam, 15 to 35 percent slopes	650	*
39A	Hermiston silt loam, 0 to 3 percent slopes	15,000	0.9
40C	Kahler silt loam, 2 to 15 percent slopes	735	*
40E	Kahler silt loam, 15 to 35 percent slopes	320	*
41F	Kahler gravelly loam, granite substratum, 35 to 70 percent slopes	2,935	0.2
42A	Kimberly fine sandy loam, 0 to 3 percent slopes	4,595	0.3
43A	Kimberly silt loam, 0 to 3 percent slopes	2,250	0.1
44D	Klicker silt loam, 2 to 20 percent slopes	4,280	0.3
45E	Klicker very stony silt loam, 20 to 40 percent slopes	1,325	0.1

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
46C	Klicker-Anatone-Bocker complex, 2 to 15 percent slopes	31,535	1.9
46E	Klicker-Anatone-Bocker complex, 15 to 35 percent slopes	10,365	0.6
47B	Koehler loamy fine sand, 0 to 5 percent slopes	440	*
48E	Lickskillet very stony loam, 7 to 40 percent slopes	36,970	2.2
49F	Lickskillet-Nansene association, 35 to 70 percent slopes	9,195	0.6
50F	Lickskillet-Rock outcrop complex, 40 to 70 percent slopes	16,475	1.0
51A	McKay silt loam, 0 to 7 percent slopes	13,090	0.8
52D	McKay silt loam, 7 to 25 percent north slopes	5,610	0.3
53D	McKay silt loam, 7 to 25 percent south slopes	1,660	0.1
54B	Mikkalo silt loam, 2 to 7 percent slopes	7,515	0.5
54C	Mikkalo silt loam, 7 to 12 percent slopes	5,490	0.3
54D	Mikkalo silt loam, 12 to 20 percent slopes	2,510	0.2
54E	Mikkalo silt loam, 20 to 35 percent slopes	1,300	0.1
55A	Mondovi silt loam, 0 to 3 percent slopes	4,765	0.3
56B	Morrow silt loam, 1 to 7 percent slopes	24,205	1.5
56C	Morrow silt loam, 7 to 12 percent slopes	11,220	0.7
56E	Morrow silt loam, 20 to 35 percent slopes	6,270	0.4
57D	Morrow silt loam, 12 to 20 percent north slopes	5,850	0.4
58D	Morrow silt loam, 12 to 20 percent south slopes	620	*
59D	Morrow-Bakeoven complex, 2 to 20 percent slopes	20,375	1.2
60F	Nansene silt loam, 35 to 70 percent slopes	7,830	0.5
61A	Oliphant silt loam, 0 to 3 percent slopes	7,475	0.5
61C	Oliphant silt loam, 3 to 12 percent slopes	1,815	0.1
62C	Oliphant silt loam, 3 to 25 percent slopes, eroded	1,730	0.1
63A	Onyx silt loam, 0 to 3 percent slopes	2,545	0.2
64B	Palouse silt loam, 1 to 7 percent slopes	5,700	0.3
64C	Palouse silt loam, 7 to 12 percent slopes	4,800	0.3
64D	Palouse silt loam, 12 to 20 percent slopes	6,205	0.4
64E	Palouse silt loam, 20 to 35 percent slopes	5,490	0.3
65A	Pedigo loamy fine sand, 0 to 3 percent slopes	295	*
66A	Pedigo silt loam, 0 to 3 percent slopes	2,590	0.2
67B	Pilot Rock silt loam, 1 to 7 percent slopes	30,905	1.9
67C	Pilot Rock silt loam, 7 to 12 percent slopes	5,660	0.3
68D	Pilot Rock silt loam, 12 to 20 percent north slopes	1,970	0.1
68E	Pilot Rock silt loam, 20 to 35 percent north slopes	410	*
69D	Pilot Rock silt loam, 12 to 20 percent south slopes	2,195	0.1
69E	Pilot Rock silt loam, 20 to 30 percent south slopes	430	*
70	Pits, gravel	495	*
71A	Potamus gravelly loam, 0 to 2 percent slopes	975	0.1
72A	Powder silt loam, 0 to 3 percent slopes	8,410	0.5
73D	Prosser silt loam, 12 to 20 percent slopes	510	*
73E	Prosser silt loam, 20 to 40 percent slopes	1,230	0.1
74B	Quincy fine sand, 0 to 5 percent slopes	9,445	0.6
75B	Quincy loamy fine sand, 0 to 5 percent slopes	16,570	1.0
75E	Quincy loamy fine sand, 5 to 25 percent slopes	11,415	0.7
76B	Quincy loamy fine sand, gravelly substratum, 0 to 5 percent slopes	8,385	0.5
77C	Quincy loamy fine sand, 0 to 25 percent slopes, eroded	1,475	0.1
78B	Quincy-Rock outcrop complex, 1 to 20 percent slopes	1,615	0.1
79B	Ritzville very fine sandy loam, 2 to 7 percent slopes	4,890	0.3
79C	Ritzville very fine sandy loam, 7 to 12 percent slopes	4,680	0.3
79D	Ritzville very fine sandy loam, 12 to 25 percent slopes	9,055	0.5
79E	Ritzville very fine sandy loam, 25 to 50 percent slopes	2,980	0.2
80B	Ritzville silt loam, 2 to 7 percent slopes	33,410	2.0
80C	Ritzville silt loam, 7 to 12 percent slopes	13,815	0.8
80D	Ritzville silt loam, 12 to 25 percent slopes	22,635	1.4
81E	Ritzville silt loam, 25 to 40 percent north slopes	4,230	0.3
82E	Ritzville silt loam, 25 to 40 percent south slopes	440	*
83C	Ritzville-Rock outcrop complex, 0 to 25 percent slopes	450	*
84	Riverwash	415	*
85F	Rock outcrop-Xeric Torriorthents complex, 10 to 70 percent slopes	1,895	0.1
86D	Rockly very cobbly loam, 2 to 20 percent slopes	5,565	0.3
87B	Sagehill fine sandy loam, 2 to 5 percent slopes	11,905	0.7
87C	Sagehill fine sandy loam, 5 to 12 percent slopes	1,300	0.1
88B	Shano very fine sandy loam, 2 to 7 percent slopes	13,885	0.8
88C	Shano very fine sandy loam, 7 to 12 percent slopes	5,930	0.4
88D	Shano very fine sandy loam, 12 to 25 percent slopes	6,475	0.4
89B	Shano silt loam, 2 to 7 percent slopes	27,670	1.7

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
89C	Shano silt loam, 7 to 12 percent slopes	6,745	0.4
89D	Shano silt loam, 12 to 25 percent slopes	5,385	0.3
89E	Shano silt loam, 25 to 40 percent slopes	620	*
90A	Silvies-Winom complex, 0 to 3 percent slopes	5,980	0.4
91A	Stanfield silt loam, 0 to 3 percent slopes	525	*
92A	Stanfield silt loam, reclaimed, 0 to 3 percent slopes	1,820	0.1
93B	Starbuck very fine sandy loam, 2 to 20 percent slopes	935	0.1
94A	Starbuck-Rock outcrop complex, 0 to 5 percent slopes	3,160	0.2
95B	Taunton fine sandy loam, 1 to 7 percent slopes	8,055	0.5
96B	Thatuna silt loam, 1 to 7 percent slopes	3,220	0.2
96D	Thatuna silt loam, 7 to 20 percent slopes	580	*
97C	Tolo silt loam, 3 to 15 percent slopes	46,185	2.8
97E	Tolo silt loam, 15 to 35 percent slopes	14,605	0.9
98C	Tolo silt loam, granite substratum, 3 to 15 percent slopes	1,330	0.1
98E	Tolo silt loam, granite substratum, 15 to 35 percent slopes	1,920	0.1
99C	Tolo-Kilmerque association, 3 to 15 percent slopes	885	0.1
99E	Tolo-Kilmerque association, 15 to 35 percent slopes	590	*
100C	Tolo-Klicker association, 3 to 15 percent slopes	19,555	1.2
100E	Tolo-Klicker association, 15 to 35 percent slopes	10,830	0.7
101A	Tolo Variant silt loam, 0 to 3 percent slopes	415	*
102C	Tutuilla silty clay loam, 1 to 15 percent slopes	1,280	0.1
103E	Tutuilla silty clay loam, 15 to 35 percent north slopes	460	*
104E	Tutuilla silty clay loam, 15 to 35 percent south slopes	1,160	0.1
105A	Umapine silt loam, 0 to 3 percent slopes	1,810	0.1
106A	Umapine silt loam, reclaimed, 0 to 3 percent slopes	3,065	0.2
107E	Umatilla-Kahler association, 15 to 35 percent slopes	1,090	0.1
107F	Umatilla-Kahler association, 35 to 70 percent slopes	9,735	0.6
108F	Umatilla-Kahler-Gwin association, 35 to 70 percent slopes	84,915	5.1
109A	Veazie silt loam, 0 to 3 percent slopes	3,515	0.2
110A	Veazie cobbly loam, 0 to 3 percent slopes	1,630	0.1
111A	Vitrandepts, 0 to 5 percent slopes	1,815	0.1
112B	Waha silty clay loam, 1 to 12 percent slopes	8,010	0.5
112D	Waha silty clay loam, 12 to 25 percent slopes	11,565	0.7
112E	Waha silty clay loam, 25 to 40 percent slopes	1,930	0.1
113D	Waha-Rockly complex, 2 to 20 percent slopes	14,075	0.9
114B	Walla Walla silt loam, 1 to 7 percent slopes	117,400	7.1
114C	Walla Walla silt loam, 7 to 12 percent slopes	37,572	2.3
115D	Walla Walla silt loam, 12 to 25 percent north slopes	21,555	1.3
115E	Walla Walla silt loam, 25 to 40 percent north slopes	2,659	0.2
116D	Walla Walla silt loam, 12 to 25 percent south slopes	18,670	1.1
117D	Walla Walla silt loam, 12 to 25 percent south slopes, eroded	2,170	0.1
118B	Walla Walla silt loam, hardpan substratum, 1 to 7 percent slopes	5,870	0.4
119A	Wanser loamy fine sand, 0 to 3 percent slopes	6,835	0.4
120C	Wanser-Quincy complex, 0 to 12 percent slopes	690	*
121B	Willis silt loam, 2 to 7 percent slopes	535	*
121C	Willis silt loam, 7 to 12 percent slopes	400	*
121D	Willis silt loam, 12 to 30 percent slopes	535	*
122B	Winchester sand, 0 to 5 percent slopes	9,935	0.6
123B	Winchester-Quinton complex, 0 to 5 percent slopes	1,385	0.1
124B	Winchester-Urban land complex, 0 to 5 percent slopes	530	*
125F	Wrentham-Rock outcrop complex, 35 to 70 percent slopes	2,300	0.1
126A	Xerofluvents, 0 to 3 percent slopes	11,795	0.7
127F	Xerollic Durorthids, 30 to 60 percent slopes	320	*
128A	Yakima silt loam, 0 to 3 percent slopes	4,160	0.3
129A	Yakima-Urban land complex, 0 to 3 percent slopes	655	*
	Total	1,653,951	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil. Capability classification and yields are not given for map units that include Urban land]

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
1B-------------- Adkins	IVe	IIe	25	110	---	---	---	8.0	---	140	---	27	---	---
1C-------------- Adkins	IVe	IVe	25	100	---	---	---	8.0	---	---	---	---	---	---
2B-------------- Adkins	IVe	IIe	12	80	---	1.0	---	6.5	---	165	---	25	---	---
2C-------------- Adkins	IVe	IVe	12	70	---	1.0	---	6.5	---	130	---	20	---	---
3A-------------- Adkins	IIw	IIw	---	---	---	---	---	6.5	---	---	---	---	---	---
3C-------------- Adkins	IIIw	IIIw	---	---	---	---	---	6.5	---	---	---	---	---	---
4B*------------- Adkins-Urban land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
5C-------------- Albee-Bocker-Anatone	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
6B-------------- Anderly	IIIs	IIIe	25	---	0.75	---	---	---	---	---	---	---	---	---
6C-------------- Anderly	IIIe	IVe	25	---	0.75	---	---	---	---	---	---	---	---	---
6D-------------- Anderly	IIIe	---	25	---	0.75	---	---	---	---	---	---	---	---	---
6E-------------- Anderly	VIe	---	---	---	0.50	---	---	---	---	---	---	---	---	---
7C*------------- Anderly-Urban land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8B-------------- Athena	IIe	IIe	75	110	1.00	2.0	3.0	6.0	---	---	---	---	2	3
8C-------------- Athena	IIIe	IIIe	75	110	1.00	2.0	3.0	6.0	---	---	---	---	2	3
9C-------------- Bocker	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
10D------------- Bocker-Bridgecreek	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
11F------------- Bowlus-Buckcreek	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
12C------------- Bridgecreek	IVe	---	---	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
12E------------- Bridgecreek	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
13F*:														
Buckcreek------	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
Gwin-----------	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
14B------------ Burbank	VIIe	IVe	---	100	---	---	---	7.0	---	---	---	25	---	---
15B------------ Burke	IVe	IIIe	20	110	---	---	---	7.0	---	140	---	---	---	---
15C------------ Burke	IVe	IIIe	15	100	---	---	---	6.0	---	120	---	---	---	---
15E------------ Burke	IVe	---	---	---	---	---	---	5.0	---	---	---	---	---	---
16B------------ Cantala	IIe	IIe	40	---	1.00	---	---	---	---	---	---	---	---	---
16C, 16D-------- Cantala	IIIe	IIIe	40	---	1.00	---	---	---	---	---	---	---	---	---
16E------------ Cantala	IVe	---	40	---	1.00	---	---	---	---	---	---	---	---	---
17A------------ Catherine Variant-Catherine	IIw	IIw	---	---	---	---	---	---	---	---	---	---	---	---
18B------------ Condon	IIIs	IIIe	30	---	0.75	---	---	---	---	---	---	---	---	---
18C------------ Condon	IIIe	IIIe	---	---	---	---	---	---	---	---	---	---	---	---
18E------------ Condon	IVe	---	30	---	0.75	---	---	---	---	---	---	---	---	---
19D------------ Condon	IIIe	---	30	---	0.75	---	---	---	---	---	---	---	---	---
20D------------ Condon	IVe	---	15	---	0.75	---	---	---	---	---	---	---	---	---
21D------------ Condon-Bakeoven	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
22C------------ Cowsly	IIIe	IIIe	40	---	1.00	---	---	---	---	---	---	---	---	---
22D------------ Cowsly	IVe	---	40	---	1.00	---	---	---	---	---	---	---	---	---
23*------------ Dune land	VIIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
24B------------ Ellisforde	IIIe	IIe	45	75	1.00	---	---	6.5	---	---	---	---	---	---
24C------------ Ellisforde	IIIe	IVe	40	75	1.00	---	---	6.0	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
25C---------- Ellisforde-Ellisforde, eroded	IVe	IVe	29	75	1.00	---	---	5.0	---	---	---	---	---	---
26E---------- Entic Durochrepts	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
27A---------- Esquatzel	IIIc	I	50	110	---	---	---	7.5	---	130	---	---	---	---
28A---------- Freewater	IVs	IIIs	40	80	---	---	---	6.5	---	---	---	---	---	---
29A---------- Freewater	VIs	IVs	---	---	---	---	---	---	---	---	---	---	---	---
30A*---------- Freewater-Urban land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
31B---------- Gurdane	IIIe	IIIe	35	---	0.75	---	---	---	---	---	---	---	---	---
31D---------- Gurdane	IVe	---	35	---	0.75	---	---	---	---	---	---	---	---	---
31E---------- Gurdane	VIe	---	35	---	0.75	---	---	---	---	---	---	---	---	---
32E*:														
Gurdane--------	VIe	---	35	---	0.75	---	---	---	---	---	---	---	---	---
Gwinly---------	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
33D---------- Gurdane-Rockly	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
34F*---------- Gwin-Klicker-Rock outcrop	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
35F*---------- Gwin-Rock outcrop	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
36E---------- Gwinly	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
37C, 37E-------- Hankins	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
38C, 38E-------- Helter	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
39A---------- Hermiston	IIc	I	60	100	1.00	2.0	1.0	6.5	---	---	---	---	---	---
40C---------- Kahler	IIIe	---	---	---	---	---	2.0	---	---	---	---	---	---	---
40E---------- Kahler	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
41F------------- Kahler	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
42A, 43A-------- Kimberly	IIIe	IIe	35	100	---	---	---	6.0	---	---	---	20	---	---
44D, 45E-------- Klicker	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
46C, 46E-------- Klicker-Anatone-Bocker	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
47B------------- Koehler	VIIe	IVe	---	90	---	---	---	6.0	---	---	---	---	---	---
48E------------- Lickskillet	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
49F*:														
Lickskillet----	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
Nansene---------	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
50F*------------ Lickskillet-Rock outcrop	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
51A------------- McKay	IIIe	IIIe	50	---	---	---	---	---	---	---	---	---	---	---
52D, 53D-------- McKay	IIIe	---	35	---	---	---	---	---	---	---	---	---	---	---
54B------------- Mikkalo	IIIe	IIIe	25	---	0.75	---	---	---	---	---	---	---	---	---
54C------------- Mikkalo	IIIe	IIIe	25	---	0.75	---	---	---	---	---	---	---	---	---
54D------------- Mikkalo	IVe	---	25	---	0.75	---	---	---	---	---	---	---	---	---
54E------------- Mikkalo	IVe	---	25	---	0.75	---	---	---	---	---	---	---	---	---
55A------------- Mondovi	IIc	I	75	---	1.00	---	2.0	---	---	---	---	---	---	---
56B, 56C-------- Morrow	IIIe	IIIe	25	---	0.75	---	---	---	---	---	---	---	---	---
56E, 57D-------- Morrow	IVe	---	25	---	0.75	---	---	---	---	---	---	---	---	---
58D------------- Morrow	VIe	---	15	---	---	---	---	---	---	---	---	---	---	---
59D------------- Morrow-Bakeoven	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
60F------------- Nansene	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
61A------------- Oliphant	IIc	I	60	---	1.00	---	1.5	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
61C------------- Oliphant	IIe	IIe	60	---	1.00	---	1.5	---	---	---	---	---	---	---
62C------------- Oliphant	IIIe	---	60	---	1.00	---	1.5	---	---	---	---	---	---	---
63A------------- Onyx	IIc	I	60	110	1.50	2.5	3.0	8.0	---	125	---	---	---	---
64B------------- Palouse	IIe	IIe	70	---	1.00	---	2.5	---	---	---	---	---	---	---
64C------------- Palouse	IIIe	IIIe	70	---	1.00	---	2.5	---	---	---	---	---	---	---
64D------------- Palouse	IVe	---	60	---	1.00	---	2.0	---	---	---	---	---	---	---
64E------------- Palouse	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
65A, 66A-------- Pedigo	IIw	IIw	40	60	1.00	---	3.0	5.0	---	---	---	---	---	---
67B------------- Pilot Rock	IIIe	IIIe	35	70	0.75	1.0	1.5	7.0	---	---	---	---	---	---
67C------------- Pilot Rock	IIIe	IIIe	35	70	0.75	1.0	1.5	7.0	---	---	---	---	---	---
68D------------- Pilot Rock	IIIe	---	35	---	0.75	---	1.5	---	---	---	---	---	---	---
68E------------- Pilot Rock	IVe	---	35	---	0.75	---	---	---	---	---	---	---	---	---
69D------------- Pilot Rock	IVe	---	25	---	0.50	---	1.0	---	---	---	---	---	---	---
69E------------- Pilot Rock	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
70*. Pits														
71A------------- Potamus	IVc	---	---	---	---	---	1.0	---	---	---	---	---	---	---
72A------------- Powder	IIc	I	---	90	---	2.0	---	7.5	---	---	---	---	---	---
73D------------- Prosser	IVe	---	---	---	---	---	---	---	---	---	---	---	---	---
73E------------- Prosser	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
74B------------- Quincy	VIIe	IVe	---	80	---	---	---	5.0	---	120	---	18	---	---
75B------------- Quincy	VIIe	IVe	---	100	---	---	---	7.0	---	130	---	25	---	---
75E------------- Quincy	VIIe	IVe	---	95	---	---	---	7.0	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
76B------------- Quincy	VIIe	IVs	---	80	---	---	---	6.5	---	150	---	25	---	---
77C------------- Quincy	VIIe	IVe	---	95	---	---	---	7.0	---	---	---	---	---	---
78B*------------ Quincy-Rock outcrop	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
79B------------- Ritzville	IIIe	IIe	35	100	1.00	---	1.5	6.0	---	---	---	25	---	---
79C------------- Ritzville	IIIe	IIIe	35	90	1.00	---	1.0	5.5	---	---	---	22	---	---
79D------------- Ritzville	IVe	---	25	80	0.50	---	1.0	5.0	---	---	---	---	---	---
79E------------- Ritzville	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
80B------------- Ritzville	IIIe	IIe	35	100	1.00	---	1.5	6.0	---	---	---	25	---	---
80C------------- Ritzville	IIIe	IIIe	35	90	1.00	---	1.0	5.5	---	---	---	22	---	---
80D------------- Ritzville	IVe	---	25	---	0.50	---	1.0	---	---	---	---	---	---	---
81E, 82E-------- Ritzville	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
83C*------------ Ritzville-Rock outcrop	IVe	---	---	---	---	---	---	---	---	---	---	---	---	---
84*------------- Riverwash	VIIIw	---	---	---	---	---	---	---	---	---	---	---	---	---
85F------------- Rock outcrop-Xeric Torriorthents	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
86D------------- Rockly	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
87B------------- Sagehill	IVe	IIe	---	110	---	---	---	8.0	---	140	---	27	---	---
87C------------- Sagehill	IVe	IIIe	---	110	---	---	---	7.0	---	130	---	25	---	---
88B------------- Shano	IVe	IIe	25	110	---	---	---	8.0	---	130	---	27	---	---
88C------------- Shano	IVe	IIIe	25	110	---	---	---	7.0	---	130	---	25	---	---
88D------------- Shano	IVe	---	20	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
89B----------- Shano	IVe	IIe	25	110	---	---	---	8.0	---	130	---	27	---	---
89C----------- Shano	IVe	IIIe	25	110	---	---	---	7.0	---	130	---	25	---	---
89D----------- Shano	IVe	IVe	20	80	---	---	---	---	---	---	---	---	---	---
89E----------- Shano	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
90A----------- Silvies-Winom	Vw	---	---	---	---	---	---	---	---	---	---	---	---	---
91A----------- Stanfield	VIs	---	---	---	---	---	---	---	---	---	---	---	---	---
92A----------- Stanfield	IVs	IIIs	---	80	---	---	---	6.0	---	---	---	---	---	---
93B----------- Starbuck	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
94A*---------- Starbuck-Rock outcrop	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
95B----------- Taunton	VIe	IVe	---	---	---	---	---	8.0	---	130	---	25	---	---
96B----------- Thatuna	IIe	IIe	55	---	1.50	---	---	---	---	---	---	---	---	---
96D----------- Thatuna	IIIe	---	---	---	1.00	---	---	---	---	---	---	---	---	---
97C, 97E, 98C, 98E----------- Tolo	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
99C*, 99E*:														
Tolo-----------	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
Kilmerque------	IVe	---	---	---	---	---	---	---	---	---	---	---	---	---
100C*, 100E*:														
Tolo-----------	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
Klicker--------	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
101A----------- Tolo Variant	Vw	---	---	---	---	---	---	---	---	---	---	---	---	---
102C----------- Tutuilla	IIIe	IIIe	25	---	---	---	2.5	---	---	---	---	---	---	---
103E, 104E------ Tutuilla	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
105A----------- Umapine	VIw	---	---	---	---	---	---	---	---	---	---	---	---	---
106A----------- Umapine	IIIc	IIs	---	100	---	---	---	7.0	---	120	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
107E*:														
Umatilla--------	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
Kahler----------	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
107F*:														
Umatilla--------	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
Kahler----------	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
108F*:														
Umatilla--------	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
Kahler----------	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
Gwin------------	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
109A------------ Veazie	IVs	IIs	40	80	---	---	---	4.0	---	---	---	---	---	---
110A------------ Veazie	IVs	IIIs	40	80	---	---	---	4.0	---	---	---	---	---	---
111A------------ Vitrandepts	IIIe	IIe	---	---	---	---	---	---	---	---	---	---	---	---
112B------------ Waha	IIIe	IIIe	35	---	1.00	---	---	---	---	---	---	---	---	---
112D------------ Waha	IVe	---	25	---	1.00	---	---	---	---	---	---	---	---	---
112E------------ Waha	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
113D------------ Waha-Rockly	VIIs	---	---	---	---	---	---	---	---	---	---	---	---	---
114B------------ Walla Walla	IIe	IIe	65	100	1.00	---	1.5	6.0	---	---	---	---	1	---
114C------------ Walla Walla	IIIe	IIIe	65	80	1.00	---	1.5	6.0	---	---	---	---	---	---
115D------------ Walla Walla	IVe	---	45	---	---	---	---	---	---	---	---	---	---	---
115E------------ Walla Walla	VIe	---	---	---	---	---	---	---	---	---	---	---	---	---
116D, 117D------ Walla Walla	IVe	---	45	---	---	---	---	---	---	---	---	---	---	---
118B------------ Walla Walla	IIe	IIe	65	100	1.00	---	1.5	8.0	---	---	---	---	1	---
119A------------ Wanser	VIw	IVw	---	---	---	---	---	---	---	---	---	---	---	---
120C------------ Wanser-Quincy	VIw	IVw	---	---	---	---	---	---	---	---	---	---	---	---
121B------------ Willis	IIIe	IIe	25	110	---	---	---	7.0	---	130	---	---	---	---

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSIFICATION AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Wheat, winter		Barley		Alfalfa hay		Corn		Potatoes, Irish		Peas, green	
	N	I	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Tons	Tons	Tons	Tons	Bu	Bu	Tons	Tons	Tons	Tons
121C------------ Willis	IIIe	IIIe	25	100	---	---	---	6.0	---	110	---	---	---	---
121D------------ Willis	IVe	---	20	---	---	---	---	---	---	---	---	---	---	---
122B------------ Winchester	VIIe	IVe	---	90	---	---	---	6.0	---	---	---	23	---	---
123B------------ Winchester-Quinton	VIIe	IVe	---	85	---	---	---	5.0	---	---	---	22	---	---
124B*----------- Winchester-Urban land	---	---	---	---	---	---	---	---	---	---	---	---	---	---
125F*----------- Wrentham-Rock outcrop	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
126A------------ Xerofluvents	VIIw	---	---	---	---	---	---	---	---	---	---	---	---	---
127F------------ Xerollic Durorthids	VIIe	---	---	---	---	---	---	---	---	---	---	---	---	---
128A------------ Yakima	IVs	IIs	40	100	---	---	---	8.0	---	---	---	---	---	---
129A*----------- Yakima-Urban land	---	---	---	---	---	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support vegetation suitable for grazing are listed, except for those that are in map units that include such soils]

Soil name and map symbol	Grazing site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
1B, 1C, 2B, 2C: Adkins	Sandy Loam, 8-10" p.z.	Favorable	800	Needleandthread	50
		Normal	500	Bluebunch wheatgrass	25
		Unfavorable	300	Big sagebrush	10
4B*:					
Adkins	Sandy Loam, 8-10" p.z.	Favorable	800	Needleandthread	50
		Normal	500	Bluebunch wheatgrass	25
		Unfavorable	300	Big sagebrush	10
Urban land.					
5C*:					
Albee	Mountain Loamy, 18-22" p.z.	Favorable	2,300	Idaho fescue	75
		Normal	1,800	Bluebunch wheatgrass	15
		Unfavorable	1,300	Prairie junegrass	5
Bocker	Very Shallow, 14+" p.z.	Favorable	600	Sandberg bluegrass	40
		Normal	400	Bluebunch wheatgrass	15
		Unfavorable	200	Stiff sagebrush	10
				Idaho fescue	5
Anatone	Shallow Loamy, 18+" p.z.	Favorable	1,600	Bluebunch wheatgrass	45
		Normal	1,000	Idaho fescue	25
		Unfavorable	500	Sandberg bluegrass	10
6B, 6C: Anderly	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	50
		Normal	1,100	Bluebunch wheatgrass	40
		Unfavorable	700		
6D, 6E: Anderly	South, 10-14" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	900	Sandberg bluegrass	10
		Unfavorable	400		
7C*:					
Anderly	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	50
		Normal	1,100	Bluebunch wheatgrass	40
		Unfavorable	700		
Urban land.					
8B, 8C: Athena	Deep Loam, 18-22" p.z.	Favorable	3,500	Idaho fescue	70
		Normal	2,500	Bluebunch wheatgrass	10
		Unfavorable	1,800	Hawthorn	5
				Common chokecherry	5
9C: Bocker	Very Shallow, 14+" p.z.	Favorable	600	Sandberg bluegrass	40
		Normal	400	Bluebunch wheatgrass	15
		Unfavorable	200	Stiff sagebrush	10
				Idaho fescue	5
10D*:					
Bocker	Very Shallow, 14+" p.z.	Favorable	600	Sandberg bluegrass	40
		Normal	400	Bluebunch wheatgrass	15
		Unfavorable	200	Stiff sagebrush	10
				Idaho fescue	5
Bridgecreek	Mountain Loamy, 18-22" p.z.	Favorable	2,300	Idaho fescue	75
		Normal	1,800	Bluebunch wheatgrass	15
		Unfavorable	1,300	Prairie junegrass	5

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Grazing site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
11F*:					
Bowlus	Deep North, 18-22" p.z.	Favorable	3,500	Idaho fescue	50
		Normal	3,000	Common snowberry	10
		Unfavorable	2,000	Hawthorn	5
				Common chokecherry	5
Buckcreek	Steep North, 18-22" p.z.	Favorable	2,500	Idaho fescue	70
		Normal	2,000	Bluebunch wheatgrass	5
		Unfavorable	1,500	Common snowberry	5
12C, 12E Bridgecreek	Mountain Loamy, 18-22" p.z.	Favorable	2,300	Idaho fescue	75
		Normal	1,800	Bluebunch wheatgrass	15
		Unfavorable	1,300	Prairie junegrass	5
13F*:					
Buckcreek	Steep North, 18-22" p.z.	Favorable	2,500	Idaho fescue	70
		Normal	2,000	Bluebunch wheatgrass	5
		Unfavorable	1,500	Common snowberry	5
Gwin	Shallow South, 14+" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	700	Idaho fescue	10
		Unfavorable	400	Sandberg bluegrass	5
14B Burbank	Sands, 8-10" p.z.	Favorable	700	Needleandthread	40
		Normal	500	Indian ricegrass	30
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
15B, 15C, 15E Burke	Loamy, 8-10" p.z.	Favorable	800	Bluebunch wheatgrass	75
		Normal	500	Sandberg bluegrass	15
		Unfavorable	300		
16B, 16C Cantala	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	50
		Normal	1,100	Bluebunch wheatgrass	40
		Unfavorable	700		
16D, 16E Cantala	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		
17A*:					
Catherine Variant	Meadow	Favorable	5,000	Tufted hairgrass	60
		Normal	4,000	Sedge	20
		Unfavorable	3,000	Baltic rush	10
Catherine	Meadow	Favorable	5,000	Tufted hairgrass	60
		Normal	4,000	Sedge	20
		Unfavorable	3,000	Baltic rush	10
18B, 18C Condon	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	50
		Normal	1,100	Bluebunch wheatgrass	40
		Unfavorable	700		
18E, 19D Condon	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		
20D Condon	South, 10-14" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	900	Sandberg bluegrass	10
		Unfavorable	400		

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Grazing site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
21D*:					
Condon	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	50
		Normal	1,100	Bluebunch wheatgrass	40
		Unfavorable	700		
Bakeoven	Very Shallow, 10-14" p.z.	Favorable	400	Sandberg bluegrass	50
		Normal	300	Stiff sagebrush	10
		Unfavorable	100	Bluebunch wheatgrass	5
22C, 22D Cowsly	Pine-Fir-Sedge	Favorable	1,000	Elk sedge	40
		Normal	800	Pinegrass	30
		Unfavorable	600	Common snowberry	5
				Spirea	5
24B, 24C Ellisforde	Loamy, 10-12" p.z.	Favorable	1,200	Bluebunch wheatgrass	80
		Normal	900	Idaho fescue	5
		Unfavorable	500	Sandberg bluegrass	5
25C*:					
Ellisforde	Loamy, 10-12" p.z.	Favorable	1,200	Bluebunch wheatgrass	80
		Normal	900	Idaho fescue	5
		Unfavorable	500	Sandberg bluegrass	5
Ellisforde, eroded	Loamy, 10-12" p.z.	Favorable	1,200	Bluebunch wheatgrass	80
		Normal	900	Idaho fescue	5
		Unfavorable	500	Sandberg bluegrass	5
31B, 31D, 31E Gurdane	Clayey, 14+" p.z.	Favorable	1,600	Idaho fescue	75
		Normal	1,100	Bluebunch wheatgrass	15
		Unfavorable	600		
32E*:					
Gurdane	Clayey, 14+" p.z.	Favorable	1,600	Idaho fescue	75
		Normal	1,100	Bluebunch wheatgrass	15
		Unfavorable	600		
Gwinly	Shallow South, 14+" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	700	Idaho fescue	10
		Unfavorable	400	Sandberg bluegrass	5
33D*:					
Gurdane	Clayey, 14+" p.z.	Favorable	1,600	Idaho fescue	75
		Normal	1,100	Bluebunch wheatgrass	15
		Unfavorable	600		
Rockly	Very Shallow, 14+" p.z.	Favorable	600	Sandberg bluegrass	40
		Normal	400	Bluebunch wheatgrass	15
		Unfavorable	200	Stiff sagebrush	10
				Idaho fescue	5
34F*:					
Gwin	Shallow South, 14+" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	700	Idaho fescue	10
		Unfavorable	400	Sandberg bluegrass	5
Klicker	Pine-Snowberry-Sedge	Favorable	1,000	Elk sedge	50
		Normal	800	Pinegrass	30
		Unfavorable	600	Common snowberry	5
				Idaho fescue	5
				Spirea	5
Rock outcrop.					

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Grazing site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
35F*:					
Gwin	Shallow South, 14+" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	700	Idaho fescue	10
		Unfavorable	400	Sandberg bluegrass	5
Rock outcrop.					
36E Gwinly	Shallow South, 14+" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	700	Idaho fescue	10
		Unfavorable	400	Sandberg bluegrass	5
37C, 37E Hankins	Pine-Snowberry-Sedge	Favorable	1,000	Elk sedge	50
		Normal	800	Pinegrass	30
		Unfavorable	600	Common snowberry	5
				Idaho fescue	5
				Spirea	5
39A Hermiston	Loamy Bottom	Favorable	6,000	Giant wildrye	75
		Normal	4,000	Basin big sagebrush	5
		Unfavorable	2,000		
42A, 43A Kimberly	Sandy Bottom	Favorable	5,000	Basin wildrye	75
		Normal	3,000	Needleandthread	10
		Unfavorable	2,000	Basin big sagebrush	5
				Bluebunch wheatgrass	5
44D, 45E Klicker	Pine-Snowberry-Sedge	Favorable	1,000	Elk sedge	50
		Normal	800	Pinegrass	30
		Unfavorable	600	Common snowberry	5
				Idaho fescue	5
				Spirea	5
46C*, 46E*:					
Klicker	Pine-Snowberry-Sedge	Favorable	1,000	Elk sedge	50
		Normal	800	Pinegrass	30
		Unfavorable	600	Common snowberry	5
				Idaho fescue	5
				Spirea	5
Anatone	Shallow Loamy, 18+" p.z.	Favorable	1,600	Bluebunch wheatgrass	45
		Normal	1,000	Idaho fescue	25
		Unfavorable	500	Sandberg bluegrass	10
Bocker	Very Shallow, 14+" p.z.	Favorable	600	Sandberg bluegrass	40
		Normal	400	Bluebunch wheatgrass	15
		Unfavorable	200	Stiff sagebrush	10
				Idaho fescue	5
47B Koehler	Sandy, 8-10" p.z.	Favorable	900	Needleandthread	80
		Normal	600	Sandberg bluegrass	5
		Unfavorable	400		
48E Lickskillet	Shallow South, 10-14" p.z.	Favorable	900	Bluebunch wheatgrass	70
		Normal	600	Sandberg bluegrass	10
		Unfavorable	300		
49F*:					
Lickskillet	Shallow South, 10-14" p.z.	Favorable	900	Bluebunch wheatgrass	70
		Normal	600	Sandberg bluegrass	10
		Unfavorable	300		
Nansene	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Grazing site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
50F*:					
Lickskillet	Shallow South, 10-14" p.z.	Favorable	900	Bluebunch wheatgrass	70
		Normal	600	Sandberg bluegrass	10
		Unfavorable	300		
Rock outcrop.					
51A McKay	South, 14+" p.z.	Favorable	1,600	Bluebunch wheatgrass	60
		Normal	1,200	Idaho fescue	15
		Unfavorable	800	Sandberg bluegrass	5
52D McKay	North, 14-18" p.z.	Favorable	2,200	Idaho fescue	70
		Normal	1,700	Bluebunch wheatgrass	10
		Unfavorable	1,200	Common snowberry	5
53D McKay	South, 14+" p.z.	Favorable	1,600	Bluebunch wheatgrass	60
		Normal	1,200	Idaho fescue	15
		Unfavorable	800	Sandberg bluegrass	5
54B, 54C, 54D, 54E Mikkalo	Loamy, 10-12" p.z.	Favorable	1,200	Bluebunch wheatgrass	80
		Normal	900	Sandberg bluegrass	5
		Unfavorable	500	Idaho fescue	5
56B, 56C Morrow	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	50
		Normal	1,100	Bluebunch wheatgrass	40
		Unfavorable	700		
56E, 57D Morrow	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		
58D Morrow	South, 10-14" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	900	Sandberg bluegrass	10
		Unfavorable	400		
59D*:					
Morrow	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	50
		Normal	1,100	Bluebunch wheatgrass	40
		Unfavorable	700		
Bakeoven	Very Shallow, 10-14" p.z.	Favorable	400	Sandberg bluegrass	50
		Normal	300	Stiff sagebrush	10
		Unfavorable	100	Bluebunch wheatgrass	5
60F Nansene	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		
61A, 61C, 62C Oliphant	Loamy, 14-18" p.z.	Favorable	2,000	Idaho fescue	75
		Normal	1,600	Bluebunch wheatgrass	15
		Unfavorable	1,100		
64B, 64C, 64D, 64E Palouse	Deep Loam, 18-22" p.z.	Favorable	3,500	Idaho fescue	75
		Normal	2,500	Bluebunch wheatgrass	15
		Unfavorable	1,800	Hawthorn	5
				Common chokecherry	5
66A Pedigo	Sodic Bottom	Favorable	4,000	Basin wildrye	70
		Normal	2,000	Inland saltgrass	10
		Unfavorable	1,500	Black greasewood	5
68D, 68E Pilot Rock	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
69D, 69E Pilot Rock	South, 10-14" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	900	Sandberg bluegrass	10
		Unfavorable	400		
71A Potamus	Loamy, 14-18" p.z.	Favorable	2,000	Idaho fescue	75
		Normal	1,600	Bluebunch wheatgrass	15
		Unfavorable	1,100		
72A Powder	Loamy Bottom	Favorable	6,000	Basin wildrye	75
		Normal	4,000	Basin big sagebrush	5
		Unfavorable	2,000		
73D, 73E Prosser	Loamy, 8-10" p.z.	Favorable	800	Bluebunch wheatgrass	75
		Normal	500	Sandberg bluegrass	15
		Unfavorable	300		
74B Quincy	Sands, 8-10" p.z.	Favorable	700	Needleandthread	60
		Normal	500	Indian ricegrass	10
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
75B Quincy	Sandy, 8-10" p.z.	Favorable	900	Needleandthread	80
		Normal	600	Sandberg bluegrass	5
		Unfavorable	400		
75E, 76B, 77C Quincy	Sands, 8-10" p.z.	Favorable	700	Needleandthread	60
		Normal	500	Indian ricegrass	10
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
78B*:					
Quincy	Sands, 8-10" p.z.	Favorable	700	Needleandthread	60
		Normal	500	Indian ricegrass	10
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
Rock outcrop.					
79B, 79C, 79D, 79E Ritzville	Sandy Loam, 10-12" p.z.	Favorable	1,200	Needleandthread	60
		Normal	900	Bluebunch wheatgrass	30
		Unfavorable	500		
80B, 80C Ritzville	Loamy, 10-12" p.z.	Favorable	1,200	Bluebunch wheatgrass	80
		Normal	900	Sandberg bluegrass	5
		Unfavorable	500	Idaho fescue	5
80D Ritzville	South, 10-14" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	900	Sandberg bluegrass	10
		Unfavorable	400		
81E Ritzville	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		
82E Ritzville	South, 10-14" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	900	Sandberg bluegrass	10
		Unfavorable	400		
83C*:					
Ritzville	Loamy, 10-12" p.z.	Favorable	1,200	Bluebunch wheatgrass	80
		Normal	900	Sandberg bluegrass	5
		Unfavorable	500	Idaho fescue	5
Rock outcrop.					

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight (Lb/acre)	Characteristic vegetation	Composition (Pct)
86D: Rockly	Very Shallow, 14+" p.z.	Favorable	600	Sandberg bluegrass	40
		Normal	400	Bluebunch wheatgrass	15
		Unfavorable	200	Stiff sagebrush	10
				Idaho fescue	5
87B, 87C: Sagehill	Sandy Loam, 8-10" p.z.	Favorable	800	Needleandthread	50
		Normal	500	Bluebunch wheatgrass	25
		Unfavorable	300	Sandberg bluegrass	10
88B, 88C, 88D, 89B, 89C: Shano	Sandy Loam, 8-10" p.z.	Favorable	800	Needleandthread	50
		Normal	500	Bluebunch wheatgrass	25
		Unfavorable	300	Sandberg bluegrass	10
89D, 89E: Shano	South, 8-10" p.z.	Favorable	700	Bluebunch wheatgrass	60
		Normal	400	Needleandthread	15
		Unfavorable	300	Sandberg bluegrass	10
90A*:					
Silvies	Wet Mountain Meadow	Favorable	2,500	Nebraska sedge	60
		Normal	1,500	Sedge	10
		Unfavorable	1,000	Baltic rush	10
				Willow	5
Winom	Dense Clay, 18+" p.z.	Favorable	2,400	California danthonia	55
		Normal	2,100	Rush	15
		Unfavorable	1,800	Sedge	5
91A: Stanfield	Sodic Bottom	Favorable	4,000	Basin wildrye	70
		Normal	2,000	Inland saltgrass	10
		Unfavorable	1,500	Black greasewood	5
93B: Starbuck	Shallow Loam, 8-10" p.z.	Favorable	500	Bluebunch wheatgrass	70
		Normal	300	Sandberg bluegrass	15
		Unfavorable	200	Needleandthread	10
				Wyoming big sagebrush	5
94A*:					
Starbuck	Shallow Loam, 8-10" p.z.	Favorable	500	Bluebunch wheatgrass	70
		Normal	300	Sandberg bluegrass	15
		Unfavorable	200	Needleandthread	10
				Wyoming big sagebrush	5
Rock outcrop.					
95B: Taunton	Sandy Loam, 8-10" p.z.	Favorable	800	Needleandthread	50
		Normal	500	Bluebunch wheatgrass	25
		Unfavorable	300	Sandberg bluegrass	10
96B, 96D: Thatuna	Loamy, 18-22" p.z.	Favorable	2,500	Idaho fescue	75
		Normal	2,000	Bluebunch wheatgrass	15
		Unfavorable	1,600		
99C, 99E:					
Tolo.					
Kilmerque	Pine-Fir-Sedge	Favorable	1,000	Elk sedge	40
		Normal	800	Pinegrass	30
		Unfavorable	600	Common snowberry	5
				Spirea	5
100C, 100E:					
Tolo.					

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Grazing site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
100C, 100E:					
Klicker	Pine-Snowberry-Sedge	Favorable	1,000	Elk sedge	50
		Normal	800	Pinegrass	30
		Unfavorable	600	Common snowberry	5
				Idaho fescue	5
				Spirea	5
102C, 103E Tutuilla	Clayey, 14+" p.z.	Favorable	1,600	Idaho fescue	75
		Normal	1,100	Bluebunch wheatgrass	15
		Unfavorable	600		
104E Tutuilla	South, 14+" p.z.	Favorable	1,600	Bluebunch wheatgrass	60
		Normal	1,200	Idaho fescue	15
		Unfavorable	800	Sandberg bluegrass	5
105A Umapine	Sodic Bottom	Favorable	4,000	Basin wildrye	70
		Normal	2,000	Inland saltgrass	10
		Unfavorable	1,500	Black greasewood	5
108F*:					
Umatilla.					
Kahler.					
Gwin	Shallow South, 14+" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	700	Idaho fescue	10
		Unfavorable	400	Sandberg bluegrass	5
109A, 110A Veazie	Pine-Willow-Cottonwood	Favorable	2,000	Elk sedge	40
		Normal	1,500	Pinegrass	20
		Unfavorable	1,000	Cottonwood	5
				Hawthorn	5
				Willow	5
112B Waha	Clayey, 14+" p.z.	Favorable	1,600	Idaho fescue	75
		Normal	1,100	Bluebunch wheatgrass	15
		Unfavorable	600		
112D, 112E Waha	South, 14+" p.z.	Favorable	1,600	Bluebunch wheatgrass	60
		Normal	1,200	Idaho fescue	15
		Unfavorable	800	Sandberg bluegrass	5
113D*:					
Waha	Clayey, 14+" p.z.	Favorable	1,600	Idaho fescue	75
		Normal	1,100	Bluebunch wheatgrass	15
		Unfavorable	600		
Rockly	Very Shallow, 14+" p.z.	Favorable	600	Sandberg bluegrass	40
		Normal	400	Bluebunch wheatgrass	15
		Unfavorable	200	Stiff sagebrush	10
				Idaho fescue	5
114B, 114C Walla Walla	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	60
		Normal	1,100	Bluebunch wheatgrass	30
		Unfavorable	700		
115D, 115E Walla Walla	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		
116D, 117D Walla Walla	South, 10-14" p.z.	Favorable	1,200	Bluebunch wheatgrass	70
		Normal	1,000	Sandberg bluegrass	10
		Unfavorable	400	Idaho fescue	5

See footnote at end of table.

TABLE 6.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
118B: Walla Walla	Loamy, 12-14" p.z.	Favorable	1,400	Idaho fescue	60
		Normal	1,100	Bluebunch wheatgrass	30
		Unfavorable	700		
119A: Wanser	Sodic Bottom	Favorable	4,000	Basin wildrye	70
		Normal	2,000	Inland saltgrass	10
		Unfavorable	1,500	Black greasewood	5
120C:					
Wanser	Sodic Bottom	Favorable	4,000	Basin wildrye	70
		Normal	2,000	Inland saltgrass	10
		Unfavorable	1,500	Black greasewood	5
Quincy	Sandy, 8-10" p.z.	Favorable	900	Needleandthread	80
		Normal	600	Sandberg bluegrass	5
		Unfavorable	400		
121B, 121C, 121D: Willis	Loamy, 8-10" p.z.	Favorable	800	Bluebunch wheatgrass	75
		Normal	500	Sandberg bluegrass	15
		Unfavorable	300		
122B: Winchester	Sands, 8-10" p.z.	Favorable	700	Needleandthread	60
		Normal	500	Indian ricegrass	10
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
123B*:					
Winchester	Sands, 8-10" p.z.	Favorable	700	Needleandthread	60
		Normal	500	Indian ricegrass	10
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
Quinton	Sands, 8-10" p.z.	Favorable	700	Needleandthread	60
		Normal	500	Indian ricegrass	10
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
124B*:					
Winchester	Sands, 8-10" p.z.	Favorable	700	Needleandthread	60
		Normal	500	Indian ricegrass	10
		Unfavorable	400	Antelope bitterbrush	15
				Thickspike wheatgrass	5
Urban land.					
125F*:					
Wrentham	North, 10-14" p.z.	Favorable	1,800	Idaho fescue	70
		Normal	1,400	Bluebunch wheatgrass	15
		Unfavorable	700		
Rock outcrop.					
128A, 129A: Yakima	Gravelly Bottom	Favorable	2,000	Bluebunch wheatgrass	45
		Normal	1,600	Basin wildrye	20
		Unfavorable	1,200	Basin big sagebrush	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed, except those that are in map units that include such soils. Absence of an entry indicates that information was not available]

Soil name and map symbol	Management concerns: Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class*	Trees to plant
22C, 22D-------- Cowsly	Slight	Moderate	Slight	Slight	Ponderosa pine------	105	8	Ponderosa pine, Douglas-fir.
37C------------- Hankins	Slight	Moderate	Moderate	Slight	Ponderosa pine------	72	4	Ponderosa pine.
					Douglas-fir---------	---	---	
37E------------- Hankins	Moderate	Moderate	Moderate	Slight	Ponderosa pine------	72	4	Ponderosa pine.
					Douglas-fir---------	---	---	
38C, 38E-------- Helter	Moderate	Slight	Slight	Moderate	Lodgepole pine------	95	6	Lodgepole pine, western larch, Engelmann spruce.
					Engelmann spruce----	115	10	
					Grand fir-----------	---	---	
					Subalpine fir-------	100	8	
					Western larch-------	---	---	
					Douglas-fir---------	---	---	
40C------------- Kahler	Slight	Moderate	Slight	Moderate	Douglas-fir---------	75	5	Ponderosa pine.
					Ponderosa pine------	---	---	
40E------------- Kahler	Moderate	Moderate	Slight	Moderate	Douglas-fir---------	75	5	Ponderosa pine.
					Ponderosa pine------	---	---	
41F------------- Kahler	Severe	Moderate	Slight	Severe	Douglas-fir---------	60	3	Douglas-fir.
					Grand fir-----------	---	---	
44D------------- Klicker	Moderate	Severe	Moderate	Severe	Ponderosa pine------	76	4	Ponderosa pine, Douglas-fir.
					Douglas-fir---------	---	---	
45E------------- Klicker	Severe	Severe	Moderate	Slight	Ponderosa pine------	76	4	Ponderosa pine, Douglas-fir.
					Douglas-fir---------	---	---	
46C**, 46E**:								
Klicker---------	Moderate	Severe	Moderate	Severe	Ponderosa pine------	76	4	Ponderosa pine, Douglas-fir.
					Douglas-fir---------	---	---	
Anatone.								
Bocker.								
97C------------- Tolo	Slight	Slight	Slight	Moderate	Western larch-------	62	6	Douglas-fir, western larch.
					Lodgepole pine------	96	6	
					Grand fir-----------	85	9	
					Douglas-fir---------	74	5	
					Ponderosa pine------	100	7	
97E------------- Tolo	Moderate	Slight	Slight	Moderate	Western larch-------	62	7	Douglas-fir, western larch.
					Lodgepole pine------	96	6	
					Grand fir-----------	85	8	
					Douglas-fir---------	74	4	
					Ponderosa pine------	100	7	
98C------------- Tolo	Slight	Slight	Slight	Moderate	Grand fir-----------	65	6	Douglas-fir, grand fir.
					Western larch-------	47	4	
					Douglas-fir---------	57	3	
					Ponderosa pine------	78	5	
98E------------- Tolo	Moderate	Slight	Slight	Moderate	Grand fir-----------	65	6	Douglas-fir, grand fir.
					Western larch-------	47	4	
					Douglas-fir---------	57	3	
					Ponderosa pine------	78	5	

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Potential productivity			Trees to plant
	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
99C**:								
Tolo	Slight	Slight	Slight	Moderate	Grand fir	65	6	Douglas-fir, grand fir.
					Western larch	47	4	
					Douglas-fir	57	3	
					Ponderosa pine	78	5	
Kilmerque	Moderate	Moderate	Moderate	Slight	Ponderosa pine	85	5	Ponderosa pine.
					Douglas-fir	60	3	
99E**:								
Tolo	Moderate	Slight	Slight	Moderate	Grand fir	65	6	Douglas-fir, grand fir.
					Western larch	47	4	
					Douglas-fir	57	3	
					Ponderosa pine	78	5	
Kilmerque	Moderate	Moderate	Moderate	Slight	Ponderosa pine	85	5	Ponderosa pine.
					Douglas-fir	60	3	
100C**:								
Tolo	Slight	Slight	Slight	Moderate	Western larch	62	6	Douglas-fir.
					Lodgepole pine	96	6	
					Grand fir	85	9	
					Douglas-fir	74	5	
					Ponderosa pine	100	7	
Klicker	Moderate	Severe	Moderate	Severe	Ponderosa pine	76	4	Ponderosa pine, Douglas-fir.
					Douglas-fir	---	---	
100E**:								
Tolo	Moderate	Slight	Slight	Moderate	Western larch	62	6	Douglas-fir, western larch.
					Lodgepole pine	96	6	
					Grand fir	85	9	
					Douglas-fir	74	5	
					Ponderosa pine	100	7	
Klicker	Moderate	Severe	Moderate	Severe	Ponderosa pine	76	4	Ponderosa pine, Douglas-fir.
					Douglas-fir	---	---	
107E**:								
Umatilla	Moderate	Slight	Slight	Severe	Douglas-fir	70	4	Douglas-fir.
					Grand fir	---	---	
					Ponderosa pine	---	---	
Kahler	Slight	Moderate	Slight	Moderate	Douglas-fir	100	---	
					Ponderosa pine	87	6	
107F**:								
Umatilla	Severe	Slight	Slight	Severe	Douglas-fir	70	4	Douglas-fir.
					Grand fir	---	---	
					Ponderosa pine	---	---	
Kahler	Severe	Moderate	Slight	Moderate	Douglas-fir	100	9	
					Ponderosa pine	87	6	
108F**:								
Umatilla	Severe	Slight	Slight	Severe	Douglas-fir	70	4	Douglas-fir.
					Grand fir	---	---	
					Ponderosa pine	---	---	

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns				Potential productivity			Trees to plant
	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
108F**:								
Kahler----------	Severe	Moderate	Slight	Moderate	Douglas-fir---------- Ponderosa pine-------	100 87	9 6	
Gwin.								

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--IRRIGATED WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil. Only the soils suited to irrigated windbreaks and environmental plantings are listed]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1B, 1C------------ Adkins	Peking cotoneaster	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Eastern redcedar, blue spruce, Rocky Mountain juniper.	Russian-olive, Douglas-fir.	Scotch pine, ponderosa pine, Austrian pine, green ash, black locust.
2B, 2C------------ Adkins	Peking cotoneaster	Honeysuckle, lilac, Siberian peashrub, blue spruce, Rocky Mountain juniper, Nanking cherry, skunkbush sumac.	Russian-olive, Douglas-fir, blue spruce.	Austrian pine, ponderosa pine, Scotch pine.	Green ash, black locust, Siberian elm.
3A, 3C------------ Adkins	Peking cotoneaster, redosier dogwood, common privet.	Nanking cherry, honeysuckle, Siberian peashrub, lilac.	Rocky Mountain juniper, Eastern redcedar, Russian-olive, blue spruce.	Austrian pine, ponderosa pine, Scotch pine, golden willow, black willow.	Green ash, Siberian elm, black locust, Lombardy poplar.
4B*:					
Adkins-----------	Peking cotoneaster	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Eastern redcedar, blue spruce, Rocky Mountain juniper.	Russian-olive, Douglas-fir.	Scotch pine, ponderosa pine, Austrian pine, green ash, black locust.
Urban land.					
6B, 6C, 6D, 6E, 7C--------------- Anderly	Peking cotoneaster	Siberian peashrub, lilac, honeysuckle, Nanking cherry.	Rocky Mountain juniper, Russian-olive, blue spruce, Eastern redcedar.	Austrian pine, Scotch pine, ponderosa pine, Douglas-fir.	Black locust, Siberian elm, green ash.
8B, 8C------------ Athena	Peking cotoneaster, redosier dogwood.	Siberian peashrub, lilac, Nanking cherry, honeysuckle, skunkbush sumac.	Blue spruce, Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, Scotch pine, Norway spruce, Douglas-fir.	Green ash, black locust, Siberian elm.
14B--------------- Burbank	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
15B, 15C, 15E----- Burke	Peking cotoneaster	Honeysuckle, Siberian peashrub, lilac, skunkbush sumac.	Rocky Mountain juniper, blue spruce, Eastern redcedar.	Austrian pine, Russian-olive.	Scotch pine, ponderosa pine, Siberian elm, black locust, green ash.
16B, 16C, 16D, 16E-------------- Cantala	Peking cotoneaster, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Russian-olive, northern white-cedar, Rocky Mountain juniper, Eastern redcedar, blue spruce.	Douglas-fir, Scotch pine, Austrian pine, ponderosa pine, Norway spruce.	Green ash, Siberian elm, Lombardy poplar.

See footnote at end of table.

TABLE 8.--IRRIGATED WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
18B, 18C, 18E, 19D, 20D---------Condon	Peking cotoneaster	Siberian peashrub, lilac, honeysuckle, Nanking cherry.	Rocky Mountain juniper, Russian-olive, blue spruce, Eastern redcedar.	Austrian pine, Scotch pine, ponderosa pine, Douglas-fir.	Black locust, Siberian elm, green ash.
21D*:					
Condon------------	Peking cotoneaster	Siberian peashrub, lilac, honeysuckle, Nanking cherry.	Rocky Mountain juniper, Russian-olive, blue spruce, Eastern redcedar.	Austrian pine, Scotch pine, ponderosa pine, Douglas-fir.	Black locust, Siberian elm, green ash.
Bakeoven.					
24B, 24C----------Ellisforde	Peking cotoneaster	Honeysuckle, Siberian peashrub, lilac.	Rocky Mountain juniper, blue spruce, Eastern redcedar.	Austrian pine, Russian-olive.	Ponderosa pine, Siberian elm, Scotch pine, black locust, green ash.
25C*:					
Ellisforde--------	Peking cotoneaster	Honeysuckle, Siberian peashrub, lilac.	Rocky Mountain juniper, blue spruce, Eastern redcedar.	Austrian pine, Russian-olive.	Ponderosa pine, Siberian elm, Scotch pine, black locust, green ash.
Ellisforde, eroded----------	Peking cotoneaster	Honeysuckle, Siberian peashrub, lilac.	Rocky Mountain juniper, blue spruce, Eastern redcedar.	Austrian pine, Russian-olive.	Ponderosa pine, Siberian elm, Scotch pine, black locust, green ash.
27A---------------Esquatzel	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lombardy poplar.
28A, 29A----------Freewater	Peking cotoneaster, common privet.	Siberian peashrub, Nanking cherry, honeysuckle, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce, Russian-olive.	Ponderosa pine, Douglas-fir, Austrian pine, Scotch pine.	Green ash, Siberian elm, black locust.
30A*:					
Freewater--------	Peking cotoneaster, common privet.	Siberian peashrub, Nanking cherry, honeysuckle, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce, Russian-olive.	Ponderosa pine, Douglas-fir, Austrian pine, Scotch pine.	Green ash, Siberian elm, black locust.
Urban land.					
31B, 31D, 31E-----Gurdane	Peking cotoneaster, redosier dogwood, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce.	Russian-olive, Douglas-fir, Austrian pine, ponderosa pine, Scotch pine.	Black locust, green ash, Siberian elm.

See footnote at end of table.

TABLE 8.--IRRIGATED WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
32E*:					
Gurdane	Peking cotoneaster, redosier dogwood, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce.	Russian-olive, Douglas-fir, Austrian pine, ponderosa pine, Scotch pine.	Black locust, green ash, Siberian elm.
Gwinly.					
33D*:					
Gurdane	Peking cotoneaster, redosier dogwood, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce.	Russian-olive, Douglas-fir, Austrian pine, ponderosa pine, Scotch pine.	Black locust, green ash, Siberian elm.
Rockly.					
39A Hermiston	Honeysuckle, skunkbush sumac.	Lilac, Siberian peashrub.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow, Austrian pine, ponderosa pine.	Green ash, Lombardy poplar, black locust, Siberian elm.
51A, 52D, 53D McKay	Redosier dogwood, skunkbush sumac, honeysuckle.	Lilac, Siberian peashrub.	Rocky Mountain juniper, Eastern redcedar, Russian-olive.	Austrian pine, ponderosa pine.	Green ash, black locust, Siberian elm.
54B, 54C, 54D, 54E Mikkalo	Peking cotoneaster, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce, Russian-olive.	Ponderosa pine, Scotch pine, Austrian pine, Douglas-fir.	Siberian elm, green ash, black locust.
55A Mondovi	Peking cotoneaster, redosier dogwood, common privet.	Nanking cherry, honeysuckle, Siberian peashrub, lilac.	Rocky Mountain juniper, Eastern redcedar, Russian-olive, blue spruce.	Austrian pine, ponderosa pine, Scotch pine, golden willow, black willow.	Green ash, Siberian elm, black locust, Lombardy poplar.
56B, 56C, 56E, 57D, 58D Morrow	Peking cotoneaster	Siberian peashrub, lilac, honeysuckle, Nanking cherry.	Rocky Mountain juniper, Russian-olive, blue spruce, Eastern redcedar.	Austrian pine, Scotch pine, ponderosa pine, Douglas-fir.	Black locust, Siberian elm, green ash.
61A, 61C, 62C Oliphant	Peking cotoneaster, skunkbush sumac.	Siberian peashrub, lilac, honeysuckle.	Rocky Mountain juniper, Russian-olive, Eastern redcedar.	Austrian pine, ponderosa pine.	Green ash, black locust, Siberian elm.
63A Onyx	Peking cotoneaster, redosier dogwood, common privet.	Nanking cherry, honeysuckle, Siberian peashrub, lilac.	Rocky Mountain juniper, Eastern redcedar, Russian-olive, blue spruce.	Austrian pine, ponderosa pine, Scotch pine, golden willow, black willow.	Green ash, Siberian elm, black locust, Lombardy poplar.
64B, 64C, 64D, 64E Palouse	Peking cotoneaster, redosier dogwood, common privet.	Honeysuckle, Nanking cherry, lilac, Siberian peashrub, skunkbush sumac.	Blue spruce, Eastern redcedar, Rocky Mountain juniper, Russian-olive.	Scotch pine, Norway spruce, Austrian pine, Douglas-fir, ponderosa pine.	Black locust, green ash, Lombardy poplar, Siberian elm.

See footnote at end of table.

TABLE 8.--IRRIGATED WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
65A, 66A: Pedigo	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lombardy poplar.
67B, 67C: Pilot Rock	Peking cotoneaster, skunkbush sumac.	Siberian peashrub, lilac, honeysuckle.	Rocky Mountain juniper, Russian-olive, Eastern redcedar.	Austrian pine, ponderosa pine.	Green ash, black locust, Siberian elm.
68D, 68E, 69D, 69E: Pilot Rock	Peking cotoneaster, skunkbush sumac.	Siberian peashrub, lilac, honeysuckle.	Rocky Mountain juniper, Russian-olive, Eastern redcedar.	Austrian pine, ponderosa pine.	Green ash, black locust, Siberian elm.
72A: Powder	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lombardy poplar.
73D, 73E: Prosser	Peking cotoneaster	Honeysuckle, lilac, Siberian peashrub, blue spruce, Rocky Mountain juniper, Nanking cherry, skunkbush sumac.	Russian-olive, Douglas-fir, blue spruce.	Austrian pine, ponderosa pine, Scotch pine.	Green ash, black locust, Siberian elm.
74B, 75B, 75E: Quincy	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
76B: Quincy	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
77C: Quincy	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
78B*:					
Quincy	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
Rock outcrop.					
79B, 79C, 79D, 79E, 80B, 80C, 80D, 81E, 82E: Ritzville	Peking cotoneaster	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Eastern redcedar, blue spruce, Rocky Mountain juniper.	Russian-olive, Douglas-fir.	Scotch pine, ponderosa pine, Austrian pine, green ash, black locust.

See footnote at end of table.

TABLE 8.--IRRIGATED WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
83C*:					
Ritzville	Peking cotoneaster	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Eastern redcedar, blue spruce, Rocky Mountain juniper.	Russian-olive, Douglas-fir.	Scotch pine, ponderosa pine, Austrian pine, green ash, black locust.
Rock outcrop.					
87B, 87C Sagehill	Peking cotoneaster	Honeysuckle, Siberian peashrub, lilac, skunkbush sumac.	Rocky Mountain juniper, blue spruce, Eastern redcedar.	Austrian pine, Russian-olive.	Scotch pine, ponderosa pine, Siberian elm, black locust, green ash.
88B, 88C, 88D, 89B, 89C, 89D, 89E Shano	Peking cotoneaster	Honeysuckle, Siberian peashrub, lilac, skunkbush sumac.	Rocky Mountain juniper, blue spruce, Eastern redcedar.	Austrian pine, Russian-olive.	Scotch pine, ponderosa pine, Siberian elm, black locust, green ash.
91A Stanfield	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lombardy poplar.
92A Stanfield	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lomabardy poplar.
93B Starbuck	Peking cotoneaster, common privet.	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Blue spruce, Rocky Mountain juniper, Eastern redcedar, Russian-olive.	Douglas-fir, Scotch pine, Austrian pine, ponderosa pine.	Siberian elm, black locust, green ash.
94A*:					
Starbuck	Peking cotoneaster, common privet.	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Blue spruce, Rocky Mountain juniper, Eastern redcedar, Russian-olive.	Douglas-fir, Scotch pine, Austrian pine, ponderosa pine.	Siberian elm, black locust, green ash.
Rock outcrop.					
95B Taunton	Peking cotoneaster, common privet.	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Blue spruce, Rocky Mountain juniper, Eastern redcedar, Russian-olive.	Douglas-fir, Scotch pine, Austrian pine, ponderosa pine.	Siberian elm, black locust, green ash.
96B, 96D Thatuna	Peking cotoneaster, redosier dogwood, common privet.	Honeysuckle, Nanking cherry, lilac, Siberian peashrub, skunkbush sumac.	Blue spruce, Eastern redcedar, Rocky Mountain juniper, Russian-olive.	Scotch pine, Norway spruce, Austrian pine, Douglas-fir, ponderosa pine.	Black locust, green ash, Lombardy poplar, Siberian elm.

See footnote at end of table.

TABLE 8.--IRRIGATED WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
105A, 106A Umapine	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lombardy poplar.
112B, 112D, 112E Waha	Peking cotoneaster, redosier dogwood, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce.	Russian-olive, Douglas-fir, Austrian pine, ponderosa pine, Scotch pine.	Black locust, green ash, Siberian elm.
113D*:					
Waha	Peking cotoneaster, redosier dogwood, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce.	Russian-olive, Douglas-fir, Austrian pine, ponderosa pine, Scotch pine.	Black locust, green ash, Siberian elm.
Rockly.					
114B, 114C, 115D, 115E, 116D, 117D, 118B Walla Walla	Peking cotoneaster, common privet.	Siberian peashrub, lilac, honeysuckle, Nanking cherry, skunkbush sumac.	Russian-olive, northern white-cedar, Rocky Mountain juniper, Eastern redcedar, blue spruce.	Douglas-fir, Scotch pine, Austrian pine, ponderosa pine, Norway spruce.	Green ash, Siberian elm, Lombardy poplar.
119A Wanser	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russian-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lombardy poplar.
120C*:					
Wanser	Redosier dogwood, honeysuckle.	Lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar.	Russina-olive, golden willow.	Austrian pine, ponderosa pine, black locust, green ash, Lombardy poplar.
Quincy	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
121B, 121C, 121D Willis	Peking cotoneaster, common privet.	Skunkbush sumac, honeysuckle, lilac, Siberian peashrub, Nanking cherry.	Blue spruce, Rocky Mountain juniper, Eastern redcedar, Russian-olive.	Douglas-fir, Scotch pine, Austrian pine, ponderosa pine.	Siberian elm, black locust, green ash.
122B Winchester	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.

See footnote at end of table.

TABLE 8.--IRRIGATED WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
123B*:					
Winchester	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
Quinton	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
124B*:					
Winchester	Peking cotoneaster, common privet.	Siberian peashrub, honeysuckle, lilac, Nanking cherry, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, blue spruce, Russian-olive.	Douglas-fir, Austrian pine.	Siberian elm, black locust, green ash, ponderosa pine, Scotch pine.
Urban land.					
128A Yakima	Peking cotoneaster, common privet.	Siberian peashrub, Nanking cherry, honeysuckle, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce, Russian-olive.	Ponderosa pine, Douglas-fir, Austrian pine, Scotch pine.	Green ash, Siberian elm, black locust.
129A*:					
Yakima	Peking cotoneaster, common privet.	Siberian peashrub, Nanking cherry, honeysuckle, skunkbush sumac.	Rocky Mountain juniper, Eastern redcedar, blue spruce, Russian-olive.	Ponderosa pine, Douglas-fir, Austrian pine, Scotch pine.	Green ash, Siberian elm, black locust.
Urban land.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1B------------------ Adkins	Slight--------------	Slight--------------	Moderate: slope.	Slight.
1C------------------ Adkins	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
2B------------------ Adkins	Slight--------------	Slight--------------	Moderate: slope.	Slight.
2C------------------ Adkins	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
3A------------------ Adkins	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
3C------------------ Adkins	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Moderate: wetness.
4B*:				
Adkins--------------	Slight--------------	Slight--------------	Moderate: slope.	Slight.
Urban land.				
5C*:				
Albee---------------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Bocker--------------	Severe: large stones, small stones.	Severe: large stones, small stones.	Severe: large stones, slope, small stones.	Moderate: large stones, dusty.
Anatone-------------	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope.	Severe: large stones.
6B------------------ Anderly	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Severe: erodes easily.
6C------------------ Anderly	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
6D------------------ Anderly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
6E------------------ Anderly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
7C*:				
Anderly-------------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Urban land.				

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
8B Athena	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
8C Athena	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
9C Bocker	Severe: large stones, small stones.	Severe: large stones, small stones.	Severe: large stones, slope, small stones.	Moderate: large stones, dusty.
10D*:				
Bocker	Severe: large stones, small stones.	Severe: large stones, small stones.	Severe: large stones, slope, small stones.	Moderate: large stones, dusty.
Bridgecreek	Moderate: slope, percs slowly, dusty.	Moderate: slope, percs slowly, dusty.	Severe: slope.	Severe: erodes easily.
11F*:				
Bowlus	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Buckcreek	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
12C Bridgecreek	Moderate: percs slowly, dusty.	Moderate: percs slowly, dusty.	Severe: slope.	Severe: erodes easily.
12E Bridgecreek	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
13F*:				
Buckcreek	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Gwin	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones, slope.
14B Burbank	Slight	Slight	Moderate: slope, small stones.	Slight.
15B Burke	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Severe: erodes easily.
15C Burke	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
15E Burke	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
16B Cantala	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
16C------------------ Cantala	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
16D------------------ Cantala	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
16E------------------ Cantala	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
17A*:				
Catherine Variant----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.
Catherine------------	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.
18B------------------ Condon	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Severe: erodes easily.
18C------------------ Condon	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
18E------------------ Condon	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
19D, 20D------------- Condon	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
21D*:				
Condon---------------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Bakeoven-------------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.
22C------------------ Cowsly	Moderate: wetness.	Moderate: wetness.	Severe: slope.	Severe: erodes easily.
22D------------------ Cowsly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
23*. Dune land				
24B------------------ Ellisforde	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
24C------------------ Ellisforde	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
25C*:				
Ellisforde	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Ellisforde, eroded	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
26E. Entic Durochrepts				
27A Esquatzel	Severe: flooding.	Moderate: dusty.	Slight	Moderate: dusty.
28A Freewater	Severe: flooding.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.
29A Freewater	Severe: flooding, small stones.	Severe: small stones.	Severe: large stones, small stones.	Moderate: large stones, dusty.
30A*:				
Freewater	Severe: flooding, small stones.	Severe: small stones.	Severe: large stones, small stones.	Moderate: large stones, dusty.
Urban land.				
31B Gurdane	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.
31D Gurdane	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
31E Gurdane	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
32E*:				
Gurdane	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Gwinly	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope, small stones.	Severe: slope.
33D*:				
Gurdane	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
Rockly	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.
34F*:				
Gwin	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones, slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
34F*:				
Klicker	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.
Rock outcrop.				
35F*:				
Gwin	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones, slope.
Rock outcrop.				
36E Gwinly	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope, small stones.	Moderate: large stones, slope.
37C Hankins	Moderate: slope, percs slowly, dusty.	Moderate: slope, percs slowly, dusty.	Severe: slope.	Moderate: dusty.
37E Hankins	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
38C Helter	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
38E Helter	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
39A Hermiston	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
40C Kahler	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
40E Kahler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
41F Kahler	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
42A Kimberly	Severe: flooding.	Slight	Slight	Slight.
43A Kimberly	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
44D Klicker	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
45E Klicker	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
46C*:				
Klicker	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Anatone	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope.	Severe: large stones.
Bocker	Severe: large stones, small stones.	Severe: large stones, small stones.	Severe: large stones, slope, small stones.	Moderate: large stones, dusty.
46E*:				
Klicker	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Anatone	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope.	Severe: large stones, slope.
Bocker	Severe: slope, large stones, small stones.	Severe: slope, large stones, small stones.	Severe: large stones, slope, small stones.	Severe: slope.
47B Koehler	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.
48E Lickskillet	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Moderate: large stones, slope.
49F*:				
Lickskillet	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.
Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
50F*:				
Lickskillet	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.
Rock outcrop.				
51A McKay	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.
52D, 53D McKay	Severe: slope, excess sodium.	Severe: slope, excess sodium.	Severe: slope, excess sodium.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
54B Mikkalo	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Severe: erodes easily.
54C Mikkalo	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
54D Mikkalo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
54E Mikkalo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
55A Mondovi	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
56B Morrow	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Severe: erodes easily.
56C Morrow	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
56E Morrow	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
57D, 58D Morrow	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
59D*: Morrow	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Bakeoven	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.
60F Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
61A Oliphant	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
61C Oliphant	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.
62C Oliphant	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
63A Onyx	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
64B Palouse	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
64C------------------ Palouse	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
64D------------------ Palouse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
64E------------------ Palouse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
65A, 66A------------- Pedigo	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
67B------------------ Pilot Rock	Moderate: dusty.	Moderate: dusty.	Moderate: slope, cemented pan, dusty.	Severe: erodes easily.
67C------------------ Pilot Rock	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
68D------------------ Pilot Rock	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
68E------------------ Pilot Rock	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
69D------------------ Pilot Rock	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
69E------------------ Pilot Rock	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
70*. Pits				
71A------------------ Potamus	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.
72A------------------ Powder	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
73D------------------ Prosser	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
73E------------------ Prosser	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
74B------------------ Quincy	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
75B------------------ Quincy	Slight--------------	Slight--------------	Moderate: slope.	Slight.
75E------------------ Quincy	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
76B------------------ Quincy	Slight--------------	Slight--------------	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
77C----- Quincy	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
78B*: Quincy-----	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Rock outcrop.				
79B----- Ritzville	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
79C----- Ritzville	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
79D----- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
79E----- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
80B----- Ritzville	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
80C----- Ritzville	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
80D----- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
81E, 82E----- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
83C*: Ritzville-----	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Rock outcrop.				
84*. Riverwash				
85F*: Rock outcrop.				
Xeric Torriorthents.				
86D----- Rockly	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.
87B----- Sagehill	Slight-----	Slight-----	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
87C: Sagehill	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
88B: Shano	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
88C: Shano	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
88D: Shano	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
89B: Shano	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
89C: Shano	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
89D: Shano	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
89E: Shano	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
90A*:				
Silvies	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Winom	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.
91A: Stanfield	Moderate: wetness, percs slowly, dusty.	Moderate: wetness, percs slowly, dusty.	Moderate: wetness.	Severe: erodes easily.
92A: Stanfield	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
93B: Starbuck	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
94A*:				
Starbuck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: erodes easily.
Rock outcrop.				
95B: Taunton	Slight	Slight	Moderate: slope, cemented pan.	Slight.
96B: Thatuna	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
96D: Thatuna	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
97C-------------------- Tolo	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
97E-------------------- Tolo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
98C-------------------- Tolo	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
98E-------------------- Tolo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
99C*:				
Tolo------------------	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
Kilmerque-------------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
99E*:				
Tolo------------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Kilmerque-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
100C*:				
Tolo------------------	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
Klicker---------------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
100E*:				
Tolo------------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Klicker---------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
101A------------------- Tolo Variant	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.
102C------------------- Tutuilla	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.
103E, 104E------------- Tutuilla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
105A------------------- Umapine	Severe: flooding, wetness, excess sodium.	Severe: excess sodium.	Severe: wetness, excess sodium.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
106A: Umapine	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.
107E*, 107F*:				
Umatilla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kahler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
108F*:				
Umatilla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kahler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Gwin	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones, slope.
109A: Veazie	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.
110A: Veazie	Severe: flooding.	Moderate: large stones, dusty.	Severe: large stones.	Moderate: dusty.
111A. Vitrandepts				
112B: Waha	Slight	Slight	Severe: slope.	Slight.
112D: Waha	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
112E: Waha	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
113D*:				
Waha	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Rockly	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.
114B: Walla Walla	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
114C: Walla Walla	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
115D: Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
115E------------------ Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
116D, 117D------------ Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
118B------------------ Walla Walla	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
119A------------------ Wanser	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
120C*:				
Wanser----------------	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Quincy----------------	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
121B------------------ Willis	Moderate: dusty.	Moderate: dusty.	Moderate: slope, cemented pan.	Severe: erodes easily.
121C------------------ Willis	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
121D------------------ Willis	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
122B------------------ Winchester	Slight---------------	Slight---------------	Moderate: slope.	Severe: too sandy.
123B*:				
Winchester------------	Slight---------------	Slight---------------	Moderate: slope.	Severe: too sandy.
Quinton---------------	Slight---------------	Slight---------------	Moderate: slope.	Slight.
124B*:				
Winchester------------	Slight---------------	Slight---------------	Moderate: slope.	Severe: too sandy.
Urban land.				
125F*:				
Wrentham--------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Rock outcrop.				
126A. Xerofluvents				
127F. Xerollic Durorthids				

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
128A------------------ Yakima	Severe: flooding.	Moderate: dusty.	Moderate: small stones, dusty.	Moderate: dusty.
129A*:				
Yakima----------------	Severe: flooding.	Moderate: dusty.	Moderate: small stones, dusty.	Moderate: dusty.
Urban land.				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1B----------------- Adkins	Slight---------	Slight---------	Slight---------	Slight---------	Severe: frost action.	Slight.
1C----------------- Adkins	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
2B----------------- Adkins	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
2C----------------- Adkins	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
3A----------------- Adkins	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness.
3C----------------- Adkins	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope, frost action.	Moderate: wetness, slope.
4B*:						
Adkins-----------	Slight---------	Slight---------	Slight---------	Slight---------	Severe: frost action.	Slight.
Urban land.						
5C*:						
Albee------------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
Bocker-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, large stones.
Anatone----------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: small stones, large stones.
6B----------------- Anderly	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: frost action.	Moderate: depth to rock.
6C----------------- Anderly	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
6D, 6E------------ Anderly	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
7C*:						
Anderly----------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
Urban land.						

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
8B---------------- Athena	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
8C---------------- Athena	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
9C---------------- Bocker	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, large stones.
10D*:						
Bocker-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, large stones.
Bridgecreek------	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope, depth to rock.
11F*:						
Bowlus-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Buckcreek--------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
12C--------------- Bridgecreek	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Moderate: depth to rock.
12E--------------- Bridgecreek	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
13F*:						
Buckcreek--------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Gwin-------------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: small stones.
14B--------------- Burbank	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
15B--------------- Burke	Severe: depth to rock, cemented pan.	Moderate: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: slope, depth to rock, cemented pan.	Severe: frost action.	Moderate: depth to rock.
15C--------------- Burke	Severe: depth to rock, cemented pan.	Moderate: slope, depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
15E--------------- Burke	Severe: depth to rock, cemented pan, slope.	Severe: slope.	Severe: depth to rock, cemented pan, slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
16B---------------- Cantala	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
16C---------------- Cantala	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
16D, 16E---------- Cantala	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
17A*:						
Catherine Variant	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.
Catherine--------	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Moderate: flooding.
18B---------------- Condon	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: frost action.	Moderate: depth to rock.
18C---------------- Condon	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
18E, 19D, 20D----- Condon	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
21D*:						
Condon------------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
Bakeoven----------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: small stones, large stones.
22C---------------- Cowsly	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
22D---------------- Cowsly	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
23*. Dune land						
24B---------------- Ellisforde	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
24C---------------- Ellisforde	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
25C*:						
Ellisforde--------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
25C*:						
Ellisforde, eroded	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
26E. Entic Durochrepts						
27A Esquatzel	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.	Slight.
28A Freewater	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, large stones.	Moderate: small stones, large stones, droughty.
29A Freewater	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, large stones.	Severe: small stones, large stones.
30A*:						
Freewater	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, large stones.	Severe: small stones, large stones.
Urban land.						
31B Gurdane	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength, frost action.	Moderate: depth to rock.
31D, 31E Gurdane	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
32E*:						
Gurdane	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
Gwinly	Severe: depth to rock, large stones, slope.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, low strength, slope.	Severe: large stones, slope, depth to rock.
33D*:						
Gurdane	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope, depth to rock.
Rockly	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock.	Severe: depth to rock, large stones.	Severe: small stones, depth to rock.
34F*:						
Gwin	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: small stones.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
34F*:						
Klicker----------	Severe: depth to rock, large stones, slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.
Rock outcrop.						
35F*:						
Gwin-------------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: small stones.
Rock outcrop.						
36E--------------- Gwinly	Severe: depth to rock, large stones, slope.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, low strength, slope.	Severe: large stones, slope, depth to rock.
37C--------------- Hankins	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
37E--------------- Hankins	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
38C--------------- Helter	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
38E--------------- Helter	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
39A--------------- Hermiston	Slight---------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.	Slight.
40C--------------- Kahler	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
40E, 41F---------- Kahler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
42A, 43A---------- Kimberly	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
44D--------------- Klicker	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.	Moderate: slope, thin layer.
45E--------------- Klicker	Severe: depth to rock, large stones, slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.
46C*:						
Klicker----------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.	Moderate: slope, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
46C*:						
Anatone	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: small stones, large stones.
Bocker	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, large stones.
46E*:						
Klicker	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
Anatone	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: small stones.
Bocker	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, large stones, slope.
47B Koehler	Severe: cemented pan, cutbanks cave.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan, frost action.	Moderate: droughty, cemented pan.
48E Lickskillet	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
49F*:						
Lickskillet	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
50F*:						
Lickskillet	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: large stones, slope, depth to rock.
Rock outcrop.						
51A McKay	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action.	Severe: excess sodium.
52D, 53D McKay	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: excess sodium, slope.
54B Mikkalo	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: depth to rock.
54C Mikkalo	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.	Moderate: slope, depth to rock.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
54D, 54E Mikkalo	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
55A Mondovi	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.	Slight.
56B Morrow	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: frost action.	Moderate: depth to rock.
56C Morrow	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
56E, 57D, 58D Morrow	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
59D*:						
Morrow	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: frost action.	Moderate: slope, depth to rock.
Bakeoven	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: small stones, large stones.
60F Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
61A Oliphant	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
61C Oliphant	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
62C Oliphant	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
63A Onyx	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.	Slight.
64B Palouse	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
64C Palouse	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
64D, 64E Palouse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
65A, 66A Pedigo	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.	Slight.
67B Pilot Rock	Severe: cemented pan, cutbanks cave.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Severe: frost action.	Moderate: cemented pan.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
67C---------------- Pilot Rock	Severe: cemented pan, cutbanks cave.	Moderate: slope, cemented pan.	Severe: cemented pan.	Severe: slope.	Severe: frost action.	Moderate: slope, cemented pan.
68D, 68E, 69D, 69E---------------- Pilot Rock	Severe: cemented pan, cutbanks cave, slope.	Severe: slope.	Severe: cemented pan, slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
70*. Pits						
71A---------------- Potamus	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.	Moderate: small stones, large stones, droughty.
72A---------------- Powder	Slight---------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: frost action.	Slight.
73D, 73E----------- Prosser	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
74B, 75B----------- Quincy	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
75E---------------- Quincy	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
76B---------------- Quincy	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
77C---------------- Quincy	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
78B*: Quincy------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Rock outcrop.						
79B---------------- Ritzville	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
79C---------------- Ritzville	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
79D, 79E----------- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
80B---------------- Ritzville	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
80C---------------- Ritzville	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
80D, 81E, 82E------ Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
83C*:						
Ritzville	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
Rock outcrop.						
84*. Riverwash						
85F*: Rock outcrop.						
Xeric Torriorthents.						
86D Rockly	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock.	Severe: depth to rock, large stones.	Severe: small stones, depth to rock.
87B Sagehill	Slight	Slight	Slight	Slight	Severe: frost action.	Slight.
87C Sagehill	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
88B Shano	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
88C Shano	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
88D Shano	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
89B Shano	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
89C Shano	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
89D, 89E Shano	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
90A*:						
Silvies	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
Winom	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
91A Stanfield	Severe: cemented pan, wetness.	Moderate: wetness, cemented pan.	Severe: wetness, cemented pan.	Moderate: wetness, cemented pan.	Moderate: cemented pan, wetness, frost action.	Moderate: wetness, cemented pan.
92A Stanfield	Moderate: cemented pan.	Slight	Moderate: cemented pan.	Slight	Moderate: frost action.	Moderate: cemented pan.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
93B---------------- Starbuck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, frost action.	Severe: depth to rock.
94A*:						
Starbuck----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, frost action.	Severe: depth to rock.
Rock outcrop.						
95B---------------- Taunton	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan, frost action.	Moderate: thin layer.
96B---------------- Thatuna	Moderate: wetness.	Slight----------	Moderate: wetness.	Moderate: slope.	Severe: frost action.	Slight.
96D---------------- Thatuna	Moderate: wetness, slope.	Moderate: slope.	Moderate: wetness, slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
97C---------------- Tolo	Moderate: slope.	Moderate: slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
97E---------------- Tolo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
98C---------------- Tolo	Moderate: slope.	Moderate: slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
98E---------------- Tolo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
99C*:						
Tolo--------------	Moderate: slope.	Moderate: slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
Kilmerque---------	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope, depth to rock.
99E*:						
Tolo--------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
Kilmerque---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
100C*:						
Tolo--------------	Moderate: slope.	Moderate: slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action.	Moderate: slope.
Klicker-----------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.	Moderate: slope, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
100E*:						
Tolo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
Klicker	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
101A Tolo Variant	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding.
102C Tutuilla	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, frost action.	Moderate: slope.
103E, 104E Tutuilla	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, frost action.	Severe: slope.
105A Umapine	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Severe: excess sodium.
106A Umapine	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: frost action.	Severe: excess sodium.
107E*, 107F*:						
Umatilla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Kahler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
108F*:						
Umatilla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Kahler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Gwin	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: small stones.
109A Veazie	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
110A Veazie	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action, large stones.	Moderate: small stones, large stones.
111A. Vitrandepts						

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
112B----------- Waha	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Moderate: depth to rock.
112D, 112E-------- Waha	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
113D*:						
Waha-----------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength.	Moderate: slope, depth to rock.
Rockly----------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock.	Severe: depth to rock, large stones.	Severe: small stones, depth to rock.
114B----------- Walla Walla	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
114C----------- Walla Walla	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
115D, 115E, 116D, 117D----------- Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
118B----------- Walla Walla	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: frost action.	Slight.
119A----------- Wanser	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
120C*:						
Wanser----------	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Quincy----------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
121B----------- Willis	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Severe: frost action.	Moderate: cemented pan.
121C----------- Willis	Severe: cemented pan.	Moderate: slope, cemented pan.	Severe: cemented pan.	Severe: slope.	Severe: frost action.	Moderate: slope, cemented pan.
121D----------- Willis	Severe: cemented pan, slope.	Severe: slope.	Severe: cemented pan, slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
122B----------- Winchester	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
123B*:						
Winchester-------	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
Quinton---------	Severe: depth to rock, cutbanks cave.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: droughty, depth to rock.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
124B*:						
Winchester	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
Urban land.						
125F*:						
Wrentham	Severe: depth to rock, large stones, slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.
Rock outcrop.						
126A. Xerofluvents						
127F. Xerollic Durorthids						
128A Yakima	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
129A*:						
Yakima	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
Urban land.						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1B Adkins	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
1C Adkins	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
2B Adkins	Slight	Severe: seepage.	Slight	Slight	Good.
2C Adkins	Severe: slope.	Severe: seepage, slope.	Severe: slope.	Severe: slope.	Poor: slope.
3A Adkins	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
3C Adkins	Severe: wetness.	Severe: seepage, slope, wetness.	Severe: wetness.	Severe: wetness.	Fair: slope, wetness.
4B*:					
Adkins	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Urban land.					
5C*:					
Albee	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Bocker	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
Anatone	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock, large stones.
6B Anderly	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
6C Anderly	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
6D, 6E Anderly	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
7C*:					
Anderly	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Urban land.					
8B Athena	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
8C Athena	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
9C Bocker	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
10D*:					
Bocker	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
Bridgecreek	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, hard to pack.
11F*:					
Bowlus	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Buckcreek	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, large stones, slope.
12C Bridgecreek	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, hard to pack.
12E Bridgecreek	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, hard to pack, slope.
13F*:					
Buckcreek	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, large stones, slope.
Gwin	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
14B Burbank	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
15B----------------- Burke	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Slight-----------	Poor: depth to rock.
15C----------------- Burke	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock, cemented pan.	Moderate: slope.	Poor: depth to rock.
15E----------------- Burke	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock, cemented pan, slope.	Severe: slope.	Poor: depth to rock, slope.
16B----------------- Cantala	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
16C----------------- Cantala	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
16D, 16E------------ Cantala	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
17A*:					
Catherine Variant--	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: small stones, wetness.
Catherine----------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
18B----------------- Condon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
18C----------------- Condon	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
18E, 19D, 20D------- Condon	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
21D*:					
Condon-------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Bakeoven-----------	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
22C----------------- Cowsly	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey.
22D----------------- Cowsly	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: wetness, slope, too clayey.	Severe: slope.	Poor: too clayey, slope.
23*. Dune land					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
24B----------------- Ellisforde	Severe: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
24C----------------- Ellisforde	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
25C*:					
Ellisforde----------	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Ellisforde, eroded-	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
26E. Entic Durochrepts					
27A----------------- Esquatzel	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
28A, 29A------------ Freewater	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy, large stones.	Severe: seepage.	Poor: seepage, too sandy, small stones.
30A*:					
Freewater-----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy, large stones.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Urban land.					
31B----------------- Gurdane	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
31D, 31E------------ Gurdane	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
32E*:					
Gurdane-------------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Gwinly--------------	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, hard to pack.
33D*:					
Gurdane-------------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Rockly--------------	Severe: depth to rock, large stones.	Severe: depth to rock, slope.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
34F*:					
Gwin	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
Klicker	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, large stones, slope.
Rock outcrop.					
35F*:					
Gwin	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
Rock outcrop.					
36E Gwinly	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, hard to pack.
37C Hankins	Severe: percs slowly.	Severe: slope.	Severe: depth to rock.	Moderate: depth to rock, slope.	Poor: small stones.
37E Hankins	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: small stones, slope.
38C Helter	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
38E Helter	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
39A Hermiston	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
40C Kahler	Moderate: depth to rock, percs slowly, slope.	Severe: slope.	Severe: depth to rock.	Moderate: depth to rock, slope.	Poor: small stones.
40E, 41F Kahler	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: small stones, slope.
42A, 43A Kimberly	Moderate: flooding.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
44D Klicker	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
45E: Klicker	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, large stones, slope.
46C*:					
Klicker	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
Anatone	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock, large stones.
Bocker	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
46E*:					
Klicker	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
Anatone	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, large stones, slope.
Bocker	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
47B: Koehler	Severe: cemented pan, poor filter.	Severe: seepage, cemented pan.	Severe: cemented pan, too sandy.	Slight	Poor: cemented pan, too sandy.
48E: Lickskillet	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
49F*:					
Lickskillet	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
50F*:					
Lickskillet	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
Rock outcrop.					
51A: McKay	Severe: percs slowly.	Moderate: seepage, slope.	Severe: excess sodium.	Slight	Poor: small stones, excess sodium.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
52D, 53D----------- McKay	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, excess sodium.	Severe: slope.	Poor: small stones, slope, excess sodium.
54B--------------- Mikkalo	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
54C--------------- Mikkalo	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
54D, 54E----------- Mikkalo	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
55A--------------- Mondovi	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
56B--------------- Morrow	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
56C--------------- Morrow	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
56E, 57D, 58D------- Morrow	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
59D*:					
Morrow------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Bakeoven-----------	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
60F--------------- Nansene	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
61A--------------- Oliphant	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Poor: small stones.
61C--------------- Oliphant	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Poor: small stones.
62C--------------- Oliphant	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
63A--------------- Onyx	Moderate: flooding, percs slowly.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.
64B--------------- Palouse	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
64C--------------- Palouse	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
64D, 64E----------- Palouse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
65A, 66A----------- Pedigo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
67B---------------- Pilot Rock	Severe: cemented pan.	Severe: seepage, cemented pan.	Severe: cemented pan, seepage.	Severe: cemented pan.	Poor: cemented pan.
67C---------------- Pilot Rock	Severe: cemented pan.	Severe: seepage, cemented pan, slope.	Severe: cemented pan, seepage.	Severe: cemented pan.	Poor: cemented pan.
68D, 68E, 69D, 69E-- Pilot Rock	Severe: cemented pan, slope.	Severe: seepage, cemented pan, slope.	Severe: cemented pan, seepage, slope.	Severe: cemented pan, slope.	Poor: cemented pan, slope.
70*. Pits					
71A---------------- Potamus	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey, large stones.	Slight-----------	Poor: small stones.
72A---------------- Powder	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
73D, 73E----------- Prosser	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
74B, 75B----------- Quincy	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: too sandy.
75E---------------- Quincy	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: too sandy, slope.
76B---------------- Quincy	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: too sandy.
77C---------------- Quincy	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
78B*: Quincy------------	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
Rock outcrop.					
79B---------------- Ritzville	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
79C---------------- Ritzville	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
79D, 79E----------- Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
80B: Ritzville	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
80C: Ritzville	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
80D, 81E, 82E: Ritzville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
83C*:					
Ritzville	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Rock outcrop.					
84*. Riverwash					
85F*:					
Rock outcrop.					
Xeric Torriorthents.					
86D: Rockly	Severe: depth to rock, large stones.	Severe: depth to rock, slope.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
87B: Sagehill	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Good.
87C: Sagehill	Moderate: percs slowly, slope.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
88B: Shano	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
88C: Shano	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
88D: Shano	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
89B: Shano	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
89C: Shano	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
89D, 89E: Shano	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
90A*:					
Silvies	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
90A*:					
Winom	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
91A Stanfield	Severe: cemented pan, wetness, percs slowly.	Severe: cemented pan, wetness.	Severe: cemented pan, wetness.	Severe: cemented pan.	Poor: cemented pan.
92A Stanfield	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: cemented pan.
93B Starbuck	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, small stones.
94A*:					
Starbuck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, small stones.
Rock outcrop.					
95B Taunton	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
96B Thatuna	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Slight	Fair: wetness.
96D Thatuna	Severe: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness, slope.	Moderate: slope.	Fair: slope, wetness.
97C Tolo	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, large stones, slope.
97E Tolo	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
98C Tolo	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
98E Tolo	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
99C*:					
Tolo	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
Kilmerque	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
99E*:					
Tolo	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
99E*:					
Kilmerque----------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, slope.
100C*:					
Tolo---------------	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, large stones, slope.
Klicker------------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
100E*:					
Tolo---------------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Klicker------------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
101A--------------- Tolo Variant	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding.
102C--------------- Tutuilla	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
103E, 104E--------- Tutuilla	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
105A--------------- Umapine	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: wetness, excess sodium.
106A--------------- Umapine	Severe: wetness.	Severe: wetness.	Severe: wetness, excess sodium.	Severe: wetness.	Poor: excess sodium.
107E*, 107F*:					
Umatilla-----------	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.	Poor: large stones, slope.
Kahler-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
108F*:					
Umatilla-----------	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.	Poor: large stones, slope.
Kahler-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
108F*:					
Gwin	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
109A, 110A Veazie	Severe: poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
111A. Vitrandepts					
112B Waha	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
112D, 112E Waha	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
113D*:					
Waha	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Rockly	Severe: depth to rock, large stones.	Severe: depth to rock, slope.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
114B Walla Walla	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
114C Walla Walla	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
115D, 115E, 116D, 117D Walla Walla	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
118B Walla Walla	Moderate: cemented pan, slope.	Moderate: seepage, cemented pan, slope.	Moderate: cemented pan.	Moderate: cemented pan.	Fair: cemented pan, thin layer.
119A Wanser	Severe: wetness, poor filter.	Severe: seepage, flooding.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
120C*:					
Wanser	Severe: wetness, poor filter.	Severe: seepage, flooding.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
Quincy	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: too sandy.
121B Willis	Severe: cemented pan.	Severe: cemented pan.	Severe: depth to rock, cemented pan.	Severe: cemented pan.	Poor: cemented pan.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
121C-----Willis	Severe: cemented pan.	Severe: cemented pan, slope.	Severe: depth to rock, cemented pan.	Severe: cemented pan.	Poor: cemented pan.
121D-----Willis	Severe: cemented pan, slope.	Severe: cemented pan, slope.	Severe: depth to rock, cemented pan, slope.	Severe: cemented pan, slope.	Poor: cemented pan, slope.
122B-----Winchester	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----	Poor: seepage, too sandy.
123B*:					
Winchester-----	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----	Poor: seepage, too sandy.
Quinton-----	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
124B*:					
Winchester-----	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----	Poor: seepage, too sandy.
Urban land.					
125F*:					
Wrentham-----	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, large stones, slope.
Rock outcrop.					
126A. Xerofluvents					
127F. Xerollic Durorthids					slope.
128A-----Yakima	Severe: poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
129A*:					
Yakima-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Urban land.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1B Adkins	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
1C Adkins	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
2B Adkins	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
2C Adkins	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
3A Adkins	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
3C Adkins	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
4B*:				
Adkins	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
5C*:				
Albee	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, thin layer.
Bocker	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Anatone	Poor: depth to rock, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones.
6B Anderly	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
6C Anderly	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
6D Anderly	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
6E Anderly	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
7C*:				
Anderly	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
Urban land.				
8B Athena	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
8C Athena	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
9C Bocker	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
10D*:				
Bocker	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Bridgecreek	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, slope.
11F*:				
Bowlus	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Buckcreek	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
12C Bridgecreek	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
12E Bridgecreek	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
13F*:				
Buckcreek	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Gwin	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, small stones, slope.
14B Burbank	Good	Probable	Probable	Poor: small stones, area reclaim.
15B Burke	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, cemented pan.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15C: Burke	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, cemented pan, slope.
15E: Burke	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
16B: Cantala	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
16C: Cantala	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
16D: Cantala	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
16E: Cantala	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
17A*:				
Catherine Variant	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, wetness.
Catherine	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
18B: Condon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
18C: Condon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
18E: Condon	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
19D, 20D: Condon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
21D*:				
Condon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
Bakeoven	Poor: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.
22C: Cowsly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
22D: Cowsly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
23*. Dune land				

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24B: Ellisforde	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
24C: Ellisforde	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
25C*:				
Ellisforde	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Ellisforde, eroded	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
26E. Entic Durochrepts				slope.
27A: Esquatzel	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
28A, 29A: Freewater	Fair: large stones.	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
30A*:				
Freewater	Fair: large stones.	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
Urban land.				
31B: Gurdane	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
31D: Gurdane	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
31E: Gurdane	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
32E*:				
Gurdane	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Gwinly	Poor: depth to rock, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones, slope.
33D*:				
Gurdane	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Rockly	Poor: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
34F*:				
Gwin	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, small stones, slope.
Klicker	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones, slope.
Rock outcrop.				
35F*:				
Gwin	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, small stones, slope.
Rock outcrop.				
36E Gwinly	Poor: depth to rock, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones, slope.
37C Hankins	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
37E Hankins	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
38C Helter	Fair: low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, slope.
38E Helter	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
39A Hermiston	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
40C Kahler	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
40E Kahler	Fair: depth to rock, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
41F Kahler	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
42A, 43A Kimberly	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
44D Klicker	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
45E----------------- Klicker	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones, slope.
46C*:				
Klicker-------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
Anatone-------------	Poor: depth to rock, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones.
Bocker--------------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
46E*:				
Klicker-------------	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
Anatone-------------	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones, slope.
Bocker--------------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
47B----------------- Koehler	Poor: cemented pan.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
48E----------------- Lickskillet	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
49F*:				
Lickskillet---------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Nansene-------------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
50F*:				
Lickskillet---------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Rock outcrop.				
51A----------------- McKay	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, excess sodium.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
52D, 53D: McKay	Fair: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, excess sodium.
54B: Mikkalo	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
54C: Mikkalo	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, slope.
54D: Mikkalo	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
54E: Mikkalo	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
55A: Mondovi	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
56B: Morrow	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
56C: Morrow	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
56E: Morrow	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
57D, 58D: Morrow	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
59D*:				
Morrow	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
Bakeoven	Poor: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.
60F: Nansene	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
61A, 61C, 62C: Oliphant	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
63A: Onyx	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
64B: Palouse	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
64C: Palouse	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
64D Palouse	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
64E Palouse	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
65A, 66A Pedigo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
67B, 67C Pilot Rock	Poor: cemented pan.	Probable	Probable	Poor: area reclaim.
68D Pilot Rock	Poor: cemented pan.	Probable	Probable	Poor: area reclaim, slope.
68E Pilot Rock	Poor: cemented pan, slope.	Probable	Probable	Poor: area reclaim, slope.
69D Pilot Rock	Poor: cemented pan.	Probable	Probable	Poor: area reclaim, slope.
69E Pilot Rock	Poor: cemented pan, slope.	Probable	Probable	Poor: area reclaim, slope.
70*. Pits				
71A Potamus	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
72A Powder	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
73D Prosser	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
73E Prosser	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
74B Quincy	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
75B Quincy	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
75E Quincy	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
76B Quincy	Good	Probable	Probable	Poor: small stones, area reclaim.
77C Quincy	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
78B*:				
Quincy	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Rock outcrop.				
79B Ritzville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
79C Ritzville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
79D Ritzville	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
79E Ritzville	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
80B Ritzville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
80C Ritzville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
80D Ritzville	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
81E, 82E Ritzville	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
83C*:				
Ritzville	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Rock outcrop.				
84*. Riverwash				
85F*:				
Rock outcrop.				
Xeric Torriorthents.				slope.
86D Rockly	Poor: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
87B Sagehill	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
87C Sagehill	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones, slope.
88B Shano	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
88C Shano	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
88D Shano	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
89B------------------ Shano	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
89C------------------ Shano	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
89D------------------ Shano	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
89E------------------ Shano	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
90A*:				
Silvies--------------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Winom----------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
91A------------------ Stanfield	Poor: cemented pan.	Improbable: excess fines.	Improbable: excess fines.	Fair: cemented pan.
92A------------------ Stanfield	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: cemented pan, thin layer.
93B------------------ Starbuck	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
94A*:				
Starbuck-------------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Rock outcrop.				
95B------------------ Taunton	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
96B------------------ Thatuna	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
96D------------------ Thatuna	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
97C------------------ Tolo	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
97E------------------ Tolo	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
98C------------------ Tolo	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
98E------------------ Tolo	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
99C*:				
Tolo	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Kilmerque	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
99E*:				
Tolo	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Kilmerque	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
100C*:				
Tolo	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Klicker	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
100E*:				
Tolo	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Klicker	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
101A Tolo Variant	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
102C Tutuilla	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
103E, 104E Tutuilla	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
105A, 106A Umapine	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
107E*, 107F*:				
Umatilla	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Kahler	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
108F*:				
Umatilla	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
108F*:				
Kahler	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Gwin	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, small stones, slope.
109A Veazie	Good	Probable	Probable	Poor: small stones, area reclaim.
110A Veazie	Fair: large stones.	Probable	Probable	Poor: small stones, area reclaim.
111A. Vitrandepts				
112B Waha	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
112D Waha	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
112E Waha	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
113D*:				
Waha	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Rockly	Poor: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
114B Walla Walla	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
114C Walla Walla	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
115D Walla Walla	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
115E Walla Walla	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
116D, 117D Walla Walla	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
118B Walla Walla	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
119A Wanser	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
120C*:				
Wanser	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Quincy	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
121B Willis	Poor: cemented pan.	Improbable: excess fines.	Improbable: excess fines.	Fair: cemented pan.
121C Willis	Poor: cemented pan.	Improbable: excess fines.	Improbable: excess fines.	Fair: cemented pan, slope.
121D Willis	Poor: cemented pan.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
122B Winchester	Good	Probable	Improbable: too sandy.	Poor: too sandy.
123B*:				
Winchester	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Quinton	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too sandy.
124B*:				
Winchester	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Urban land.				
125F*:				
Wrentham	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones, slope.
Rock outcrop.				
126A. Xerofluvents				
127F. Xerollic Durorthids				
128A Yakima	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
129A*:				
Yakima	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Urban land.				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
1B Adkins	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing	Erodes easily, soil blowing.	Erodes easily.
1C Adkins	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
2B Adkins	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Soil blowing	Too arid.
2C Adkins	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Too arid, slope.
3A Adkins	Severe: seepage.	Severe: piping, wetness.	Favorable	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
3C Adkins	Severe: seepage, slope.	Severe: piping, wetness.	Slope	Wetness, soil blowing, slope.	Slope, erodes easily, wetness.	Slope, erodes easily.
4B*:						
Adkins	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing	Erodes easily, soil blowing.	Erodes easily.
Urban land.						
5C*:						
Albee	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Bocker	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Anatone	Severe: depth to rock, slope.	Severe: piping, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
6B Anderly	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
6C, 6D, 6E Anderly	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
7C*:						
Anderly	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Urban land.						
8B Athena	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
8C----- Athena	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
9C----- Bocker	Severe: depth to rock.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty.
10D*:						
Bocker-----	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Bridgecreek-----	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
11F*:						
Bowlus-----	Severe: slope.	Severe: piping.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.
Buckcreek-----	Severe: slope.	Severe: thin layer.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
12C----- Bridgecreek	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
12E----- Bridgecreek	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
13F*:						
Buckcreek-----	Severe: slope.	Severe: thin layer.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Gwin-----	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
14B----- Burbank	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Large stones, too sandy.	Large stones, droughty.
15B----- Burke	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, cemented pan.	Too arid, erodes easily.
15C, 15E----- Burke	Severe: slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, cemented pan.	Too arid, slope, erodes easily.
16B----- Cantala	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
16C, 16D, 16E----- Cantala	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
17A*: Catherine Variant	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Wetness, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
17A*:						
Catherine	Moderate: seepage.	Severe: piping.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Erodes easily.
18B Condon	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
18C, 18E, 19D, 20D Condon	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
21D*:						
Condon	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Bakeoven	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
22C Cowsly	Moderate: slope.	Moderate: wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Wetness	Percs slowly.
22D Cowsly	Severe: slope.	Moderate: wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Slope, wetness.	Slope, percs slowly.
23*. Dune land						
24B Ellisforde	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, rooting depth.	Erodes easily	Erodes easily, rooting depth.
24C Ellisforde	Severe: slope.	Severe: piping.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
25C*:						
Ellisforde	Severe: slope.	Severe: piping.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Ellisforde, eroded	Severe: slope.	Severe: piping.	Deep to water	Slope, soil blowing, rooting depth.	Slope, erodes easily, soil blowing.	Slope, erodes easily, rooting depth.
26E. Entic Durochrepts						
27A Esquatzel	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Too arid, erodes easily.
28A Freewater	Severe: seepage.	Severe: seepage.	Deep to water	Large stones, droughty.	Large stones, too sandy.	Large stones, droughty.
29A Freewater	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, droughty.	Large stones, too sandy.	Large stones, droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
30A*:						
Freewater	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, droughty.	Large stones, too sandy.	Large stones, droughty.
Urban land.						
31B Gurdane	Moderate: depth to rock, slope.	Moderate: thin layer, large stones.	Deep to water	Large stones, percs slowly, depth to rock.	Large stones, depth to rock.	Large stones, erodes easily.
31D, 31E Gurdane	Severe: slope.	Moderate: thin layer, large stones.	Deep to water	Large stones, percs slowly, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
32E*:						
Gurdane	Severe: slope.	Moderate: thin layer, large stones.	Deep to water	Large stones, percs slowly, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
Gwinly	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, percs slowly.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
33D*:						
Gurdane	Severe: slope.	Moderate: thin layer, large stones.	Deep to water	Large stones, percs slowly, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
Rockly	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
34F*:						
Gwin	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Klicker	Severe: slope.	Severe: large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop.						
35F*:						
Gwin	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
36E Gwinly	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, percs slowly.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
37C, 37E Hankins	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily, percs slowly.
38C, 38E Helter	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
39A Hermiston	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
40C, 40E----------- Kahler	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
41F---------------- Kahler	Severe: slope.	Severe: thin layer.	Deep to water	Slope-----------	Slope, large stones.	Large stones, slope.
42A---------------- Kimberly	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Too sandy------	Favorable.
43A---------------- Kimberly	Severe: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily, too sandy.	Erodes easily.
44D, 45E----------- Klicker	Severe: slope.	Severe: large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
46C*, 46E*:						
Klicker-----------	Severe: slope.	Severe: large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Anatone-----------	Severe: depth to rock, slope.	Severe: piping, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Bocker------------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
47B---------------- Koehler	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Cemented pan, too sandy.	Too arid, droughty.
48E---------------- Lickskillet	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
49F*:						
Lickskillet-------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Nansene-----------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
50F*:						
Lickskillet-------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
51A---------------- McKay	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily	Excess sodium, erodes easily.
52D, 53D----------- McKay	Severe: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily.	Slope, excess sodium, erodes easily.
54B---------------- Mikkalo	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
54C, 54D, 54E----- Mikkalo	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
55A---------------- Mondovi	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
56B---------------- Morrow	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
56C, 56E, 57D, 58D-------------- Morrow	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
59D*:						
Morrow-----------	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Bakeoven---------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
60F---------------- Nansene	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
61A---------------- Oliphant	Moderate: seepage.	Slight---------	Deep to water	Erodes easily	Erodes easily	Erodes easily.
61C---------------- Oliphant	Moderate: seepage, slope.	Slight---------	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
62C---------------- Oliphant	Severe: slope.	Slight---------	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
63A---------------- Onyx	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
64B---------------- Palouse	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
64C, 64D, 64E----- Palouse	Severe: slope.	Severe: piping.	Deep to water	Slope-----------	Slope, erodes easily.	Slope, erodes easily.
65A, 66A---------- Pedigo	Moderate: seepage.	Severe: piping.	Frost action---	Wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
67B---------------- Pilot Rock	Moderate: seepage, cemented pan, slope.	Severe: piping.	Deep to water	Cemented pan, slope, erodes easily.	Cemented pan, erodes easily.	Erodes easily, cemented pan.
67C, 68D, 68E, 69D, 69E--------- Pilot Rock	Severe: slope.	Severe: piping.	Deep to water	Cemented pan, slope, erodes easily.	Slope, cemented pan, erodes easily.	Slope, erodes easily, cemented pan.
70*. Pits						

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
71A----------------- Potamus	Moderate: seepage.	Moderate: large stones.	Deep to water	Droughty--------	Large stones----	Large stones, droughty.
72A----------------- Powder	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
73D, 73E----------- Prosser	Severe: slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
74B, 75B----------- Quincy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
75E----------------- Quincy	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
76B----------------- Quincy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
77C----------------- Quincy	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
78B*:						
Quincy------------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Rock outcrop.						
79B----------------- Ritzville	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
79C, 79D, 79E------ Ritzville	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope, erodes easily.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
80B----------------- Ritzville	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
80C, 80D, 81E, 82E---------------- Ritzville	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
83C*:						
Ritzville---------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Rock outcrop.						
84*. Riverwash						
85F*:						
Rock outcrop.						
Xeric Torriorthents.						

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
86D: Rockly	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
87B: Sagehill	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Erodes easily, soil blowing.	Erodes easily.
87C: Sagehill	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
88B: Shano	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
88C, 88D: Shano	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope, erodes easily.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
89B: Shano	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
89C, 89D, 89E: Shano	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
90A*:						
Silvies	Slight	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Winom	Slight	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
91A: Stanfield	Moderate: seepage, cemented pan.	Moderate: thin layer, wetness.	Percs slowly, cemented pan.	Wetness, percs slowly, cemented pan.	Cemented pan, erodes easily, wetness.	Erodes easily, cemented pan, percs slowly.
92A: Stanfield	Moderate: seepage, cemented pan.	Severe: piping.	Deep to water	Cemented pan, erodes easily.	Cemented pan, erodes easily.	Erodes easily, cemented pan.
93B: Starbuck	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
94A*:						
Starbuck	Severe: depth to rock.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Rock outcrop.						
95B: Taunton	Moderate: seepage, cemented pan, slope.	Severe: piping.	Deep to water	Cemented pan, slope.	Cemented pan, erodes easily.	Erodes easily, cemented pan.
96B: Thatuna	Moderate: seepage, slope.	Severe: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
96D: Thatuna	Severe: slope.	Severe: piping.	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
97C, 97E Tolo	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
98C, 98E Tolo	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
99C*, 99E*:						
Tolo	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Kilmerque	Severe: seepage, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
100C*, 100E*:						
Tolo	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Klicker	Severe: slope.	Severe: large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
101A Tolo Variant	Moderate: seepage.	Severe: piping, ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Erodes easily, ponding.	Wetness, erodes easily.
102C, 103E, 104E Tutuilla	Severe: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
105A Umapine	Moderate: seepage.	Severe: piping, wetness, excess sodium.	Flooding, frost action.	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, excess sodium, erodes easily.
106A Umapine	Moderate: seepage.	Severe: piping, excess sodium.	Frost action, excess sodium.	Wetness, erodes easily.	Erodes easily, wetness.	Excess sodium, erodes easily.
107E*, 107F*:						
Umatilla	Severe: slope.	Moderate: large stones.	Deep to water	Large stones, slope.	Slope, large stones.	Large stones, slope.
Kahler	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
108F*:						
Umatilla	Severe: slope.	Moderate: large stones.	Deep to water	Large stones, slope.	Slope, large stones.	Large stones, slope.
Kahler	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
Gwin	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
109A Veazie	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Large stones, erodes easily, too sandy.	Large stones, erodes easily.
110A Veazie	Severe: seepage.	Severe: seepage.	Deep to water	Large stones	Large stones, too sandy.	Large stones.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
111A. Vitrandepts						
112B----------- Waha	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
112D, 112E-------- Waha	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
113D*:						
Waha-----------	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Rockly----------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
114B------------- Walla Walla	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
114C, 115D, 115E, 116D, 117D------- Walla Walla	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
118B------------- Walla Walla	Moderate: seepage, cemented pan, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
119A------------- Wanser	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
120C*:						
Wanser----------	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Quincy----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
121B------------- Willis	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Cemented pan, slope.	Cemented pan, erodes easily.	Erodes easily, cemented pan.
121C, 121D-------- Willis	Severe: slope.	Severe: piping.	Deep to water	Cemented pan, slope.	Slope, cemented pan, erodes easily.	Slope, erodes easily, cemented pan.
122B------------- Winchester	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
123B*:						
Winchester-------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
123B*:						
Quinton	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Depth to rock	Droughty, depth to rock.
124B*:						
Winchester	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Urban land.						
125F*:						
Wrentham	Severe: slope.	Severe: piping, large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
Rock outcrop.						
126A. Xerofluvents						
127F. Xerollic Durorthids						
128A Yakima	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth, erodes easily.	Erodes easily, too sandy.	Erodes easily, rooting depth.
129A*:						
Yakima	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth, erodes easily.	Erodes easily, too sandy.	Erodes easily, rooting depth.
Urban land.						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1B, 1C----------- Adkins	0-4	Fine sandy loam	SM, ML	A-4	0	100	100	85-100	40-55	---	NP
	4-35	Very fine sandy loam, fine sandy loam.	SM, ML	A-4	0	100	100	85-100	40-55	---	NP
	35-60	Very fine sandy loam, fine sandy loam.	SM, ML	A-4	0	100	100	85-100	40-55	---	NP
2B, 2C----------- Adkins	0-4	Fine sandy loam	SM, ML	A-4	0	95-100	90-100	65-85	35-55	---	NP
	4-45	Fine sandy loam	SM, ML	A-4	0	95-100	90-100	65-85	35-55	---	NP
	45-60	Very gravelly fine sandy loam, very gravelly loamy sand.	GM	A-1	0-15	40-60	35-50	20-45	10-25	---	NP
3A, 3C----------- Adkins	0-12	Fine sandy loam	SM	A-4	0	95-100	90-100	65-85	35-50	---	NP
	12-60	Fine sandy loam	SM	A-2, A-4	0	85-100	80-90	55-75	30-50	---	NP
4B*:											
Adkins----------	0-4	Fine sandy loam	SM, ML	A-4	0	100	100	85-100	40-55	---	NP
	4-35	Very fine sandy loam, fine sandy loam.	SM, ML	A-4	0	100	100	85-100	40-55	---	NP
	35-60	Very fine sandy loam, fine sandy loam.	SM, ML	A-4	0	100	100	85-100	40-55	---	NP
Urban land.											
5C*:											
Albee-----------	0-10	Silt loam--------	ML	A-4	0	90-100	90-100	85-100	65-90	25-35	NP-10
	10-19	Loam, silt loam	ML	A-4	0	90-100	90-100	85-100	65-90	25-35	NP-10
	19-28	Clay loam, gravelly loam, silt loam.	GC, CL	A-6	0	55-95	55-95	40-90	30-85	30-40	10-20
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bocker----------	0-4	Very cobbly silt loam.	GM	A-4	30-40	55-65	45-60	40-50	35-45	20-30	NP-5
	4-7	Very gravelly loam, very cobbly silt loam, extremely cobbly loam.	GM	A-2	0-45	50-60	40-50	35-45	25-35	20-30	NP-5
	7	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Anatone---------	0-4	Very cobbly silt loam.	GM	A-2, A-4	20-55	50-60	40-50	35-45	30-40	25-35	NP-10
	4-17	Very gravelly silt loam, very cobbly loam, extremely cobbly loam.	GM, ML	A-2, A-4, A-1	20-70	40-70	35-55	25-55	20-55	25-35	NP-10
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
6B, 6C, 6D, 6E--- Anderly	0-13	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	85-95	20-25	NP-5
	13-24	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	85-95	20-25	NP-5
	24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
7C*:											
Anderly----------	0-13	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	85-95	20-25	NP-5
	13-24	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	85-95	20-25	NP-5
	24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
8B, 8C----------- Athena	0-26	Silt loam--------	ML	A-4	0	100	100	95-100	95-100	25-40	NP-10
	26-46	Silt loam--------	ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	46-65	Silt loam--------	ML	A-4	0	100	100	95-100	95-100	25-40	NP-10
9C--------------- Bocker	0-4	Very cobbly silt loam.	GM	A-4	30-40	55-65	45-60	40-50	35-45	20-30	NP-5
	4-7	Very gravelly loam, very cobbly silt loam, extremely cobbly loam.	GM	A-2	0-45	50-60	40-50	35-45	25-35	20-30	NP-5
	7	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
10D*:											
Bocker-----------	0-4	Very cobbly silt loam.	GM	A-4	30-40	55-65	45-60	40-50	35-45	20-30	NP-5
	4-7	Very gravelly loam, very cobbly silt loam, extremely cobbly loam.	GM	A-2	0-45	50-60	40-50	35-45	25-35	20-30	NP-5
	7	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bridgecreek------	0-16	Silt loam--------	ML	A-4	0	90-100	85-100	75-100	60-90	30-40	5-15
	16-26	Silty clay loam	CL, CH	A-7	0-10	90-100	85-95	80-95	70-90	40-60	20-30
	26-32	Clay-------------	CH	A-7	0-10	90-100	85-95	75-95	65-90	50-75	25-50
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---
11F*:											
Bowlus-----------	0-19	Silt loam--------	ML	A-4, A-6	0	100	100	90-100	75-90	30-40	5-15
	19-42	Silt loam, silty clay loam.	ML	A-4, A-7	0	95-100	95-100	95-100	75-95	35-50	5-20
	42-60	Silty clay loam, cobbly silty clay loam, very cobbly silty clay loam.	GM, ML	A-6, A-7	0-45	50-100	45-100	40-100	35-95	35-50	10-20
Buckcreek--------	0-11	Silt loam--------	CL-ML, CL	A-4, A-6	0-10	90-100	85-95	75-95	60-85	25-40	5-20
	11-23	Cobbly silt loam, cobbly silty clay loam, silt loam.	CL	A-6	5-30	75-95	70-90	65-85	50-80	30-40	10-20
	23-36	Very cobbly silty clay loam.	GC, CL	A-7	40-55	50-85	45-80	40-80	35-75	40-50	20-30
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
12C, 12E--------- Bridgecreek	0-16	Silt loam--------	ML	A-4	0	90-100	85-100	75-100	60-90	30-40	5-15
	16-26	Silty clay loam	CL, CH	A-7	0-10	90-100	85-95	80-95	70-90	40-60	20-30
	26-32	Clay-------------	CH	A-7	0-10	90-100	85-95	75-95	65-90	50-75	25-50
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
13F*:											
Buckcreek	0-11	Silt loam	CL-ML, CL	A-4, A-6	0-10	90-100	85-95	75-95	60-85	25-40	5-20
	11-23	Cobbly silt loam, cobbly silty clay loam, silt loam.	CL	A-6	5-30	75-95	70-90	65-85	50-80	30-40	10-20
	23-36	Very cobbly silty clay loam.	GC, CL	A-7	40-55	50-85	45-80	40-80	35-75	40-50	20-30
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gwin	0-7	Extremely stony silt loam.	GM	A-2, A-4	45-70	45-60	35-55	35-55	30-50	25-30	NP-5
	7-13	Very cobbly silty clay loam, extremely cobbly silty clay loam, extremely gravelly clay loam.	GC	A-2, A-6	30-70	40-55	25-50	20-50	20-45	30-40	10-20
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
14B Burbank	0-6	Loamy fine sand	SM	A-2	0-5	95-100	85-95	60-80	15-35	---	NP
	6-25	Loamy fine sand, gravelly loamy sand, loamy sand.	SM	A-2	0-5	85-95	70-90	60-80	15-35	---	NP
	25-30	Very gravelly loamy sand, very gravelly loamy fine sand.	SM, SP-SM, GM, GP-GM	A-1	5-20	50-75	30-45	20-35	5-15	---	NP
	30-60	Extremely gravelly sand, very cobbly coarse sand, extremely gravelly loamy sand.	GP, GP-GM	A-1	15-50	35-45	10-40	5-20	0-10	---	NP
15B, 15C, 15E Burke	0-8	Silt loam	ML	A-4	0	100	95-100	85-95	75-95	20-30	NP-5
	8-26	Silt loam, very fine sandy loam.	ML	A-4	0	100	95-100	95-100	80-95	20-30	NP-5
	26	Indurated	---	---	---	---	---	---	---	---	---
16B, 16C, 16D, 16E Cantala	0-18	Silt loam	ML	A-4	0	95-100	95-100	95-100	80-90	30-35	5-10
	18-54	Silt loam	ML	A-4	0	95-100	95-100	95-100	80-90	30-35	5-10
	54-60	Silt loam, loam	ML	A-4	0	90-100	90-100	75-100	55-90	30-35	5-10
17A*:											
Catherine Variant	0-25	Silt loam	ML	A-4	0	95-100	90-100	80-100	65-90	25-40	NP-10
	25-60	Very gravelly silt loam, very gravelly loam.	GM	A-2, A-4	5-15	40-60	35-55	30-50	25-45	25-35	NP-10
Catherine	0-25	Silt loam	ML	A-4	0	100	100	95-100	80-95	30-35	5-10
	25-60	Silt loam, silty clay loam.	ML	A-4, A-6	0	100	100	95-100	80-95	30-40	5-15
	48-60	Stratified very gravelly silt loam to sandy loam.	SM, ML, GM	A-2, A-4	0-15	50-90	45-85	40-80	25-60	20-30	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
18B, 18C, 18E, 19D, 20D-------- Condon	0-8	Silt loam--------	ML, CL-ML	A-4	0	100	95-100	95-100	80-90	25-35	5-10
	8-30	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-90	25-35	5-15
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
21D*: Condon----------	0-8	Silt loam--------	ML, CL-ML	A-4	0	100	95-100	95-100	80-90	25-35	5-10
	8-30	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-90	25-35	5-15
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bakeoven--------	0-3	Very cobbly loam	GM	A-2, A-4	35-60	50-70	40-65	35-55	30-50	25-35	NP-10
	3-8	Very gravelly clay loam, very cobbly loam, very gravelly loam.	GM	A-4, A-6	20-55	50-65	45-60	40-55	35-50	30-40	5-15
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
22C, 22D--------- Cowsly	0-5	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	20-35	NP-10
	5-19	Silt loam, silty clay loam.	ML	A-6	0	100	100	90-100	70-90	35-50	10-20
	19-42	Clay, silty clay	CL	A-7	0	80-100	75-100	65-100	55-95	45-60	25-35
	42-60	Cobbly clay, cobbly clay loam, silty clay loam.	CL	A-6, A-7	0-30	80-100	75-100	65-100	55-95	35-50	15-25
23*. Dune land											
24B, 24C--------- Ellisforde	0-10	Silt loam--------	ML	A-4	0	100	100	95-100	60-90	20-30	NP-5
	10-28	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	28-60	Stratified silt loam to very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
25C*: Ellisforde------	0-10	Silt loam--------	ML	A-4	0	100	100	95-100	60-90	20-30	NP-5
	10-28	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	28-60	Stratified silt loam to very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
Ellisforde, eroded---------	0-6	Very fine sandy loam.	ML	A-4	0	100	100	95-100	55-65	20-30	NP-5
	6-22	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	22-60	Stratified silt loam to very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
26E. Entic Durochrepts											

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
27A---------------- Esquatzel	0-9	Silt loam----------	ML	A-4	0	100	100	95-100	75-90	---	NP
	9-21	Silt loam----------	ML	A-4	0	100	100	95-100	80-95	20-30	NP-5
	21-60	Stratified silt loam to fine sandy loam.	ML	A-4	0	100	100	95-100	60-90	20-30	NP-5
28A---------------- Freewater	0-4	Gravelly silt loam.	ML, GM	A-4	0-15	65-85	60-75	55-75	40-70	25-35	NP-10
	4-20	Very gravelly loam.	GM	A-2, A-4, A-1	5-25	35-55	30-50	25-50	20-40	25-35	NP-10
	20-60	Extremely cobbly sand, extremely gravelly sand, extremely cobbly loamy sand.	GP, GP-GM	A-1	15-55	20-30	15-25	10-20	0-10	---	NP
29A---------------- Freewater	0-4	Very cobbly loam	GM	A-2, A-4	25-40	45-70	40-65	35-60	25-50	25-35	NP-10
	4-20	Very gravelly loam.	GM	A-2, A-4, A-1	5-25	35-55	30-50	25-50	20-40	25-35	NP-10
	20-60	Extremely cobbly sand, extremely gravelly sand, extremely cobbly loamy sand.	GP, GP-GM	A-1	15-55	20-30	15-25	10-20	0-10	---	NP
30A*: Freewater---------	0-4	Very cobbly loam	GM	A-2, A-4	25-40	45-70	40-65	35-60	25-50	25-35	NP-10
	4-20	Very gravelly loam.	GM	A-2, A-4, A-1	5-25	35-55	30-50	25-50	20-40	25-35	NP-10
	20-60	Extremely cobbly sand, extremely gravelly sand, extremely cobbly loamy sand.	GP, GP-GM	A-1	15-55	20-30	15-25	10-20	0-10	---	NP
Urban land.											
31B, 31D, 31E----- Gurdane	0-9	Silty clay loam	CL	A-7	0	95-100	90-100	85-100	80-90	40-50	20-30
	9-20	Silty clay loam	CL	A-7	0-10	90-100	85-95	80-95	70-90	40-50	20-30
	20-30	Very cobbly clay, extremely cobbly clay.	GC, CH, SC	A-2, A-7	30-65	35-75	25-70	20-70	20-60	50-60	30-40
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
32E*: Gurdane-----------	0-9	Silty clay loam	CL	A-7	0	95-100	90-100	85-100	80-90	40-50	20-30
	9-20	Silty clay loam	CL	A-7	0-10	90-100	85-95	80-95	70-90	40-50	20-30
	20-30	Very cobbly clay, extremely cobbly clay.	GC, CH, SC	A-2, A-7	30-65	35-75	25-70	20-70	20-60	50-60	30-40
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gwinly------------	0-2	Very cobbly silt loam.	ML	A-4	30-50	75-95	70-90	65-90	60-85	25-30	NP-5
	2-7	Very cobbly silty clay loam, very gravelly clay loam.	GC	A-6, A-2	5-55	40-60	30-55	25-55	20-50	35-40	15-20
	7-15	Very cobbly clay, extremely cobbly clay.	CH, GC	A-7	45-85	55-80	50-75	45-74	40-70	50-60	25-35
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
33D*:											
Gurdane	0-9	Silty clay loam	CL	A-7	0	95-100	90-100	85-100	80-90	40-50	20-30
	9-20	Silty clay loam	CL	A-7	0-10	90-100	85-95	80-95	70-90	40-50	20-30
	20-30	Very cobbly clay, extremely cobbly clay.	GC, CH, SC	A-2, A-7	30-65	35-75	25-70	20-70	20-60	50-60	30-40
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rockly	0-6	Very cobbly loam	GM	A-2, A-4	40-60	50-75	45-70	35-65	25-50	25-30	NP-5
	6	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
34F*:											
Gwin	0-7	Extremely stony silt loam.	GM	A-2, A-4	45-70	45-60	35-55	35-55	30-50	25-30	NP-5
	7-13	Very cobbly silty clay loam, extremely cobbly silty clay loam, extremely gravelly clay loam.	GC	A-2, A-6	30-70	40-55	25-50	20-50	20-45	30-40	10-20
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Klicker	0-7	Very stony silt loam.	CL, CL-ML	A-4, A-6	10-25	75-90	65-85	50-80	50-75	25-35	5-15
	7-21	Very cobbly silt loam, gravelly silt loam.	CL, GC	A-6	15-40	55-80	50-65	40-60	40-60	25-35	10-15
	21	Very cobbly silt loam, very cobbly silty clay loam, cobbly loam.	CL, SC	A-6, A-2	35-65	70-85	40-80	35-80	30-60	30-40	10-20
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
35F*:											
Gwin	0-7	Extremely stony silt loam.	GM	A-2, A-4	45-70	45-60	35-55	35-55	30-50	25-30	NP-5
	7-13	Very cobbly silty clay loam, extremely cobbly silty clay loam, extremely gravelly clay loam.	GC	A-2, A-6	30-70	40-55	25-50	20-50	20-45	30-40	10-20
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
36E------------- Gwinly	0-2	Very cobbly silt loam.	ML	A-4	30-50	75-95	70-90	65-90	60-85	25-30	NP-5
	2-7	Very cobbly silty clay loam, very gravelly clay loam.	GC	A-6, A-2	5-55	40-60	30-55	25-55	20-50	35-40	15-20
	7-15	Very cobbly clay, extremely cobbly clay.	CH, GC	A-7	45-85	55-80	50-75	45-74	40-70	50-60	25-35
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
37C, 37E--------- Hankins	0-9	Silt loam--------	CL	A-4, A-6	0	95-100	90-100	80-100	65-90	30-40	5-15
	9-20	Silty clay loam	CL, CH	A-7	0	95-100	90-100	85-100	75-95	40-60	20-30
	20-26	Clay-------------	CH	A-7	0-10	90-100	85-100	75-100	65-95	35-75	20-50
	26-44	Clay loam, cobbly clay loam, gravelly clay loam.	ML	A-6, A-7	0-25	75-100	70-100	65-100	50-80	35-50	10-20
	44	Weathered bedrock	---	---	---	---	---	---	---	---	---
38C, 38E--------- Helter	0-6	Silt loam--------	ML	A-4, A-5	0	100	100	95-100	85-95	35-45	NP-5
	6-33	Silt loam--------	ML	A-4, A-5	0	100	100	95-100	85-95	35-45	NP-5
	33-40	Silt loam, silty clay loam, loam.	ML	A-4, A-6, A-5	0	100	90-100	85-100	75-95	30-50	5-15
	40-60	Gravelly silt loam, cobbly silty clay loam.	ML	A-4, A-6, A-7	5-15	70-90	65-85	60-85	50-80	30-50	5-20
39A------------- Hermiston	0-24	Silt loam--------	ML	A-4	0	100	100	95-100	70-90	20-25	NP-5
	24-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	70-90	20-25	NP-5
40C, 40E--------- Kahler	0-23	Silt loam--------	ML	A-4	0-10	90-100	85-95	75-95	50-85	25-35	NP-5
	23-35	Gravelly loam, clay loam, cobbly silt loam.	ML, SM, GM	A-4	0-25	75-95	70-90	60-90	50-85	30-40	5-10
	35-50	Cobbly loam, gravelly loam, cobbly silt loam.	ML, GM	A-4	5-30	60-85	55-80	45-75	35-65	25-35	NP-5
	50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
41F------------- Kahler	0-12	Gravelly loam----	CL-ML, CL, SC, SM-SC	A-4, A-6	0-10	75-95	60-75	50-70	35-60	25-40	5-15
	12-22	Gravelly loam, loam.	CL-ML, CL, SC, SM-SC	A-4, A-6	0-10	75-95	60-90	50-85	35-70	25-40	5-15
	22-45	Cobbly sandy clay loam, gravelly sandy clay loam.	SC	A-2, A-6, A-7	5-40	75-95	55-85	40-75	25-50	30-45	10-20
	45	Weathered bedrock	---	---	---	---	---	---	---	---	---
42A------------- Kimberly	0-10	Fine sandy loam	SM	A-4, A-2	0	100	100	60-90	30-55	---	NP
	10-26	Sandy loam, fine sandy loam.	SM	A-4, A-2	0	100	100	60-80	30-50	20-25	NP-5
	26-60	Stratified fine sandy loam to sand.	SM	A-4, A-2	0	100	100	55-80	25-40	20-25	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
43A--------------- Kimberly	0-10	Silt loam---------	ML	A-4	0	100	100	70-100	50-90	20-25	NP-5
	10-26	Sandy loam, fine sandy loam.	SM	A-4, A-2	0	100	100	60-80	30-50	20-25	NP-5
	26-60	Stratified fine sandy loam to sand.	SM	A-4, A-2	0	100	100	55-80	25-40	20-25	NP-5
44D--------------- Klicker	0-7	Silt loam---------	ML	A-4	0-5	80-95	75-90	70-85	65-80	20-30	NP-5
	7-21	Very cobbly silt loam, very cobbly silty clay loam.	CL	A-6	35-45	70-85	65-80	55-65	50-60	30-40	10-20
	21	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
45E--------------- Klicker	0-7	Very stony silt loam.	CL, CL-ML	A-4, A-6	10-25	75-90	65-85	50-80	50-75	25-35	5-15
	7-21	Very cobbly silt loam, gravelly silt loam.	CL, GC	A-6	15-40	55-80	50-65	40-60	40-60	25-35	10-15
	21	Very cobbly silt loam, very cobbly silty clay loam, cobbly loam.	CL, SC	A-6, A-2	35-65	70-85	40-80	35-80	30-60	30-40	10-20
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
46C*, 46E*: Klicker----------	0-7	Silt loam---------	ML	A-4	0-5	80-95	75-90	70-85	65-80	20-30	NP-5
	7-21	Very cobbly silt loam, very cobbly silty clay loam.	CL	A-6	35-45	70-85	65-80	55-65	50-60	30-40	10-20
	21	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Anatone----------	0-5	Very cobbly silt loam.	GM	A-2, A-4	20-55	50-60	40-50	35-45	30-40	25-35	NP-10
	5-12	Very gravelly silt loam, very cobbly loam, extremely cobbly loam.	GM, ML	A-2, A-4, A-1	20-70	40-70	35-55	25-55	20-55	25-35	NP-10
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bocker-----------	0-4	Very cobbly silt loam.	GM	A-4	30-40	55-65	45-60	40-50	35-45	20-30	NP-5
	4-7	Very gravelly loam, very cobbly silt loam, extremely cobbly loam.	GM	A-2	0-45	50-60	40-50	35-45	25-35	20-30	NP-5
	7	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
47B--------------- Koehler	0-11	Loamy fine sand	SM	A-2	0-5	85-95	80-90	70-80	15-30	---	NP
	11-24	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0-5	80-90	75-85	65-80	15-25	---	NP
	24	Indurated---------	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
48E------------- Lickskillet	0-2	Very stony loam	CL-ML	A-4	20-30	80-90	70-80	60-70	50-60	25-30	5-10
	2-18	Very gravelly clay loam, very gravelly loam, very cobbly loam.	GC, GM	A-2, A-6, A-7	15-50	40-65	35-50	25-50	20-40	35-45	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
49F*:											
Lickskillet-----	0-2	Very stony loam	CL-ML	A-4	20-30	80-90	70-80	60-70	50-60	25-30	5-10
	2-18	Very gravelly clay loam, very gravelly loam, very cobbly loam.	GC, GM	A-2, A-6, A-7	15-50	40-65	35-50	25-50	20-40	35-45	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Nansene---------	0-20	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
	20-60	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
	45-60	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
50F*:											
Lickskillet-----	0-2	Extremely stony loam.	SM, GM, ML	A-4	30-50	60-90	60-85	50-80	35-65	30-35	5-10
	2-18	Very gravelly clay loam, very gravelly loam, very cobbly loam.	GC, GM	A-2, A-6, A-7	15-50	40-65	35-50	25-50	20-40	35-45	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
51A, 52D, 53D---- McKay	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	95-100	90-100	80-100	65-90	25-35	5-15
	14-25	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	95-100	80-95	35-50	15-25
	25-60	Gravelly silt loam, gravelly silty clay loam, very gravelly loam.	CL, GC, SC	A-2, A-6, A-7	10-25	55-80	45-75	40-75	30-65	35-45	15-25
54B, 54C, 54D, 54E------------- Mikkalo	0-16	Silt loam--------	ML	A-4	0	100	95-100	95-100	80-95	20-30	NP-5
	16-38	Silt loam--------	ML	A-4	0	100	90-100	90-100	80-90	20-30	NP-5
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
55A------------- Mondovi	0-10	Silt loam--------	ML	A-4	0	100	95-100	95-100	80-90	20-40	NP-10
	10-60	Silt loam--------	ML	A-4	0	100	95-100	95-100	80-90	20-40	NP-10
56B, 56C, 56E, 57D, 58D-------- Morrow	0-10	Silt loam--------	ML	A-4	0	95-100	95-100	95-100	80-90	30-35	5-10
	10-15	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	95-100	95-100	95-100	80-95	35-45	10-20
	15-27	Silt loam, silty clay loam.	ML	A-4	0	95-100	95-100	95-100	80-90	30-35	5-10
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
59D*:											
Morrow----------	0-10	Silt loam--------	ML	A-4	0	95-100	95-100	95-100	80-90	30-35	5-10
	10-15	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	95-100	95-100	95-100	80-95	35-45	10-20
	15-27	Silt loam, silty clay loam.	ML	A-4	0	95-100	95-100	95-100	80-90	30-35	5-10
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bakeoven--------	0-3	Very cobbly loam	GM	A-2, A-4	35-60	50-70	40-65	35-55	30-50	25-35	NP-10
	3-8	Very gravelly clay loam, very cobbly loam, very gravelly loam.	GM	A-4, A-6	20-55	50-65	45-60	40-55	35-50	30-40	5-15
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
60F-------------- Nansene	0-20	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
	20-60	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
	45-60	Silt loam--------	ML	A-4	0	95-100	95-100	90-100	85-90	20-25	NP-5
61A-------------- Oliphant	0-9	Silt loam--------	CL-ML	A-4	0	100	100	90-100	75-90	20-30	5-10
	9-16	Silt loam--------	CL-ML	A-4	0	100	100	90-100	75-90	20-30	5-10
	16-26	Silt loam--------	CL-ML	A-4	0	95-100	90-100	90-100	75-90	20-30	5-10
	26-41	Silt loam--------	CL-ML	A-4	0	95-100	90-100	90-100	75-90	20-30	5-10
	41-60	Very gravelly silt loam, gravelly silt loam.	GM-GC, SM-SC	A-4, A-2	0-5	55-85	30-75	20-65	15-50	20-30	5-10
61C-------------- Oliphant	0-9	Silt loam--------	CL-ML	A-4	0	100	100	90-100	75-90	20-30	5-10
	9-16	Silt loam--------	CL-ML	A-4	0	100	100	90-100	75-90	20-30	5-10
	16-26	Silt loam--------	CL-ML	A-4	0	95-100	90-100	90-100	75-90	20-30	5-10
	26-41	Silt loam--------	CL-ML	A-4	0	95-100	90-100	90-100	75-90	20-30	5-10
	41-60	Very gravelly silt loam, gravelly silt loam.	GM-GC, SM-SC	A-4, A-2	0-5	55-85	30-75	20-65	15-50	20-30	5-10
62C-------------- Oliphant	0-9	Silt loam--------	CL-ML	A-4	0	100	100	90-100	75-90	20-30	5-10
	9-16	Silt loam--------	CL-ML	A-4	0	100	100	90-100	75-90	20-30	5-10
	16-26	Silt loam--------	CL-ML	A-4	0	95-100	90-100	90-100	75-90	20-30	5-10
	26-41	Silt loam--------	CL-ML	A-4	0	95-100	90-100	90-100	75-90	20-30	5-10
	41-60	Very gravelly silt loam, gravelly silt loam.	GM-GC, SM-SC	A-4, A-2	0-5	55-85	30-75	20-65	15-50	20-30	5-10
63A-------------- Onyx	0-12	Silt loam--------	ML	A-4	0	100	100	95-100	75-100	20-25	NP-5
	12-60	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	20-30	NP-5
64B, 64C, 64D, 64E------------- Palouse	0-27	Silt loam--------	ML	A-4	0	100	100	95-100	90-100	30-40	5-10
	27-60	Silt loam, silty clay loam.	ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
65A-------------- Pedigo	0-21	Loamy fine sand	SM	A-2	0	100	100	85-100	15-30	---	NP
	21-60	Stratified very fine sandy loam to silty clay loam.	ML	A-4	0	100	100	95-100	70-95	25-40	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
66A--------------- Pedigo	0-21	Silt loam--------	ML	A-4	0	100	100	95-100	80-95	25-40	NP-10
	21-60	Stratified very fine sandy loam to silty clay loam.	ML	A-4	0	100	100	95-100	70-95	25-40	NP-10
67B, 67C, 68D, 68E, 69D, 69E--- Pilot Rock	0-10	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	80-90	20-30	NP-10
	10-27	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	80-90	20-30	NP-10
	27-45	Indurated--------	---	---	---	---	---	---	---	---	---
	45-60	Very gravelly sandy loam, very gravelly sand, extremely gravelly sand.	GP, GP-GM, GM	A-1	5-25	20-50	15-45	5-30	0-15	---	NP
70*. Pits											
71A--------------- Potamus	0-4	Gravelly loam----	CL, SC, GC	A-6	0-15	65-80	65-75	50-75	35-60	30-40	10-20
	4-15	Gravelly loam, gravelly clay loam.	CL, SC, GC	A-6	0-15	65-80	65-75	55-70	40-65	35-40	15-20
	15-60	Very gravelly clay loam, extremely gravelly clay loam.	GC	A-2, A-7	15-30	25-65	25-60	20-55	15-50	40-50	20-30
72A--------------- Powder	0-15	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	20-30	NP-5
	15-27	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	27-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	90-100	90-100	65-90	20-30	NP-5
73D, 73E--------- Prosser	0-4	Silt loam--------	ML	A-4	0	100	95-100	85-95	50-90	20-30	NP-5
	4-24	Very fine sandy loam, silt loam.	ML	A-4	0-5	95-100	90-100	80-90	50-80	20-30	NP-5
	24-30	Very fine sandy loam, silt loam.	ML, SM	A-4	0-5	85-100	80-95	70-85	40-75	20-30	NP-5
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
74B--------------- Quincy	0-4	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	75-90	5-20	---	NP
	4-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	10-30	---	NP
75B, 75E--------- Quincy	0-4	Loamy fine sand	SM	A-2	0	100	100	85-100	15-30	---	NP
	4-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	10-30	---	NP
76B--------------- Quincy	0-4	Loamy fine sand	SM	A-2	0	100	95-100	75-90	15-35	---	NP
	4-41	Loamy fine sand, fine sand, gravelly fine sand.	SM	A-1, A-2	0-5	65-100	60-95	45-80	10-35	---	NP
	41-60	Very gravelly fine sand, very gravelly loamy fine sand, very gravelly sand.	GP, GP-GM, GM	A-1	0-15	30-55	25-50	10-45	0-15	---	NP
77C--------------- Quincy	0-4	Loamy fine sand	SM	A-2	0	100	100	85-100	15-30	---	NP
	4-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	10-30	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
78B*:											
Quincy----------	0-4	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	75-90	5-20	---	NP
	4-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	10-30	---	NP
Rock outcrop.											
79B, 79C, 79D, 79E------------- Ritzville	0-9	Very fine sandy loam.	ML	A-4	0	100	95-100	90-95	50-65	---	NP
	9-36	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	---	NP
	36-60	Silt loam--------	ML	A-4	0	100	100	95-100	75-90	---	NP
80B, 80C, 80D, 81E, 82E-------- Ritzville	0-5	Silt loam--------	ML	A-4	0	100	95-100	95-100	70-90	---	NP
	5-36	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	---	NP
	36-60	Silt loam--------	ML	A-4	0	100	100	95-100	75-90	---	NP
83C*:											
Ritzville-------	0-5	Silt loam--------	ML	A-4	0	100	95-100	95-100	70-90	---	NP
	5-36	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	---	NP
	36-60	Silt loam--------	ML	A-4	0	100	100	95-100	75-90	---	NP
Rock outcrop.											
84*. Riverwash											
85F*: Rock outcrop.											
Xeric Torriorthents.											
86D-------------- Rockly	0-6	Very cobbly loam	GM	A-2, A-4	40-60	50-75	45-70	35-65	25-50	25-30	NP-5
	6	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
87B, 87C--------- Sagehill	0-8	Fine sandy loam	ML, SM	A-4	0-5	95-100	95-100	90-95	45-60	---	NP
	8-27	Very fine sandy loam, fine sandy loam, loamy very fine sand.	ML, SM	A-4	0-5	95-100	95-100	90-95	45-60	---	NP
	27-60	Stratified silt loam to fine sandy loam.	ML	A-4	0-5	95-100	95-100	90-95	60-75	---	NP
88B, 88C, 88D---- Shano	0-13	Very fine sandy loam.	ML, SM	A-4	0	100	100	90-100	40-55	---	NP
	13-28	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	---	NP
	28-60	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	---	NP
89B, 89C, 89D, 89E------------ Shano	0-6	Silt loam--------	ML	A-4	0	100	100	95-100	75-80	---	NP
	6-18	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	---	NP
	18-65	Silt loam--------	ML	A-4	0	100	100	95-100	80-90	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
90A*:											
Silvies	0-15	Silt loam	ML	A-4	0	100	100	90-100	70-90	25-40	5-15
	15-35	Silty clay loam, clay.	CL, CH	A-7	0	100	100	90-100	75-95	40-65	20-40
	35-60	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	45-65	20-40
Winom	0-13	Silty clay loam	CL	A-7	0	95-100	90-100	85-100	75-95	40-50	20-30
	13-28	Clay, silty clay	CH	A-7	0	95-100	90-100	80-100	65-95	55-75	35-50
	28-60	Silty clay loam, clay, silty clay.	CL, CH	A-7	0	95-100	90-100	80-100	65-95	45-70	25-50
91A Stanfield	0-6	Silt loam	ML	A-4	0	100	100	85-100	65-90	20-25	NP-5
	6-22	Silt loam, loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-90	20-25	NP-5
	22-70	Indurated	---	---	---	---	---	---	---	---	---
	70-86	Silt loam	ML	A-4	0	100	100	90-100	80-90	20-25	NP-5
92A Stanfield	0-6	Silt loam	ML	A-4	0	100	100	95-100	75-90	25-35	NP-5
	6-30	Silt loam	ML	A-4	0	100	100	95-100	75-90	25-35	NP-5
	30	Indurated	---	---	---	---	---	---	---	---	---
93B Starbuck	0-10	Very fine sandy loam.	ML, SM	A-4	0-5	100	90-100	80-90	45-55	---	NP
	10-18	Silt loam, fine sandy loam, gravelly silt loam.	ML, SM, GM	A-4, A-2	0-15	65-90	60-85	50-60	30-60	20-30	NP-5
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
94A*:											
Starbuck	0-10	Very fine sandy loam.	ML, SM	A-4	0-5	100	90-100	80-90	45-55	---	NP
	10-18	Silt loam, fine sandy loam, gravelly silt loam.	ML, SM, GM	A-4, A-2	0-15	65-90	60-85	50-60	30-60	20-30	NP-5
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
95B Taunton	0-6	Fine sandy loam	SM	A-4	0	95-100	90-100	80-90	40-50	---	NP
	6-11	Fine sandy loam, very fine sandy loam, silt loam.	SM, ML	A-4	0	95-100	90-100	80-95	40-70	15-25	NP-5
	11-26	Gravelly fine sandy loam, very fine sandy loam, gravelly silt loam.	SM	A-2, A-4	0	65-90	50-85	35-65	30-50	15-25	NP-5
	26	Indurated	---	---	---	---	---	---	---	---	---
96B, 96D Thatuna	0-37	Silt loam	ML	A-4	0	100	100	95-100	95-100	25-35	NP-5
	37-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	15-20
97C Tolo	0-33	Silt loam	ML	A-4, A-5	0	100	100	95-100	85-90	35-45	NP-5
	33-60	Silt loam, silty clay loam.	ML	A-6	0-25	85-100	80-100	75-100	55-95	30-40	10-20
	60-70	Cobbly clay loam	CL	A-6	20-40	80-90	80-90	60-80	50-70	25-30	10-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
97E------------- Tolo	0-4	Silt loam--------	ML	A-4, A-5	0	100	100	95-100	85-90	35-45	NP-5
	4-22	Silt loam, silty clay loam.	ML	A-6	0-25	85-100	80-100	75-100	55-95	30-40	10-20
	22-60	Cobbly clay loam	CL	A-6	20-40	80-90	80-90	60-80	50-70	25-30	10-15
98C, 98E--------- Tolo	0-12	Silt loam--------	ML	A-4, A-5	0	100	100	90-100	85-90	30-45	NP-5
	12-31	Silt loam--------	ML	A-4, A-5	0	100	100	90-100	85-90	30-45	NP-5
	31-60	Gravelly sandy loam, gravelly sandy clay loam, very gravelly sandy clay loam.	SC	A-2, A-6, A-4	0-30	60-80	45-75	25-60	15-40	25-40	5-20
99C*, 99E*: Tolo------------	0-12	Silt loam--------	ML	A-4, A-5	0	100	100	90-100	85-90	30-45	NP-5
	12-31	Silt loam--------	ML	A-4, A-5	0	100	100	90-100	85-90	30-45	NP-5
	31-60	Gravelly sandy loam, gravelly sandy clay loam, very gravelly sandy clay loam.	SC	A-2, A-6, A-4	0-30	60-80	45-75	25-60	15-40	25-40	5-20
Kilmerque-------	0-4	Loam-------------	CL-ML, ML	A-4	0	95-100	85-100	70-90	55-70	20-30	NP-10
	4-12	Loam, sandy loam	CL-ML, SM-SC, ML, SM	A-4, A-2	0	95-100	85-100	55-85	25-65	20-30	NP-10
	12-32	Gravelly sandy loam.	SM	A-2	0	65-80	55-75	35-50	20-30	10-20	NP-5
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---
100C*, 100E*: Tolo------------	0-4	Silt loam--------	ML	A-4, A-5	0	100	100	95-100	85-90	35-45	NP-5
	4-22	Silt loam, silty clay loam.	ML	A-6	0-25	85-100	80-100	75-100	55-95	30-40	10-20
	22-60	Cobbly clay loam	CL	A-6	20-40	80-90	80-90	60-80	50-70	25-30	10-15
Klicker---------	0-7	Silt loam--------	ML	A-4	0-5	80-95	75-90	70-85	65-80	20-30	NP-5
	7-21	Very cobbly silt loam, very cobbly silty clay loam.	CL	A-6	35-45	70-85	65-80	55-65	50-60	30-40	10-20
	21	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
101A------------ Tolo Variant	0-14	Silt loam--------	ML	A-4, A-5	0	100	100	95-100	80-90	25-45	NP-10
	14-26	Silt loam--------	ML	A-4, A-5	0	100	100	95-100	80-90	35-45	NP-5
	26-60	Silt loam--------	CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-15
102C, 103E, 104E- Tutuilla	0-19	Silty clay loam	ML	A-6, A-7	0	95-100	90-100	85-100	75-95	35-50	10-20
	19-35	Silty clay, clay	CL, CH	A-7	0-5	90-100	85-100	75-100	65-95	45-75	25-50
	35-50	Clay, clay loam, silty clay.	CL, CH	A-6, A-7	0-10	95-100	90-95	80-95	65-90	35-75	20-50
	50	Weathered bedrock	---	---	---	---	---	---	---	---	---
105A, 106A------- Umapine	0-7	Silt loam--------	ML	A-4	0	100	100	95-100	75-85	20-30	NP-5
	7-60	Silt loam--------	ML	A-4	0	100	100	95-100	75-85	20-30	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
107E*, 107F*:											
Umatilla	0-12	Loam	CL-ML, CL	A-4, A-6	0-10	90-100	85-100	70-90	50-70	25-40	5-20
	12-28	Cobbly clay loam, cobbly silty clay loam, cobbly loam.	GC, CL, SC, GM	A-6, A-7, A-4, A-5	15-30	70-95	70-90	60-85	40-80	30-50	5-25
	28-60	Very cobbly clay loam, very cobbly silty clay loam.	GC, CL, SC	A-2, A-7	30-55	50-75	45-70	40-70	30-65	40-50	20-30
Kahler	0-8	Silt loam	ML	A-4	0-10	90-100	85-95	75-95	60-85	25-35	NP-10
	8-22	Silt loam, silty clay loam, clay loam.	ML	A-4, A-6, A-7	0-10	90-95	85-95	75-95	60-85	30-45	5-15
	22-64	Loam, gravelly loam, gravelly silty clay loam.	ML, GM, SM	A-4, A-5, A-6, A-7	0-30	55-85	50-80	45-75	35-70	30-50	5-20
108F*:											
Umatilla	0-7	Loam	CL-ML, CL	A-4, A-6	0-10	90-100	85-100	70-90	50-70	25-40	5-20
	7-13	Cobbly clay loam, cobbly silty clay loam, cobbly loam.	GC, CL, SC, GM	A-6, A-7, A-4, A-5	15-30	70-95	70-90	60-85	40-80	30-50	5-25
	13	Very cobbly clay loam, very cobbly silty clay loam.	GC, CL, SC	A-2, A-7	30-55	50-75	45-70	40-70	30-65	40-50	20-30
Kahler	0-8	Silt loam	ML	A-4	0-10	90-100	85-95	75-95	60-85	25-35	NP-10
	8-22	Silt loam, silty clay loam, clay loam.	ML	A-4, A-6, A-7	0-10	90-95	85-95	75-95	60-85	30-45	5-15
	22-64	Loam, gravelly loam, gravelly silty clay loam.	ML, GM, SM	A-4, A-5, A-6, A-7	0-30	55-85	50-80	45-75	35-70	30-50	5-20
Gwin	0-5	Extremely stony silt loam.	GM	A-2, A-4	45-70	45-60	35-55	35-55	30-50	25-30	NP-5
	5-14	Very cobbly silty clay loam, extremely cobbly silty clay loam, extremely gravelly clay loam.	GC	A-2, A-6	30-70	40-55	25-50	20-50	20-45	30-40	10-20
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
109A Veazie	0-18	Silt loam	ML	A-4	0	95-100	90-100	75-95	55-75	25-30	NP-5
	18-60	Very gravelly sand, very gravelly loamy sand, extremely cobbly sand.	GP-GM, GP, SP, SP-SM	A-1	5-50	45-60	40-55	15-35	0-10	---	NP
110A Veazie	0-18	Cobbly loam	GM, ML, SM	A-4	20-25	70-80	70-75	50-70	40-55	25-30	NP-5
	18-60	Very gravelly sand, very gravelly loamy sand, extremely cobbly sand.	GP-GM, GP, SP, SP-SM	A-1	5-50	45-60	40-55	15-35	0-10	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
111A. Vitrandepts											
112B------------- Waha	0-13	Silty clay loam	CL	A-6	0	100	95-100	90-100	85-95	30-40	10-20
	13-23	Silty clay loam, silt loam.	CL	A-6	0	100	95-100	95-100	85-95	30-40	10-20
	23-28	Very gravelly clay loam, very cobbly silt loam, extremely gravelly clay loam.	GC	A-2, A-6	25-40	25-45	15-45	15-40	10-40	30-40	10-20
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
112D, 112E------- Waha	0-12	Silty clay loam	CL	A-6	0	100	95-100	90-100	85-95	30-40	10-20
	12-28	Silty clay loam, silt loam.	CL	A-6	0	100	95-100	95-100	85-95	30-40	10-20
	28-38	Very gravelly clay loam, very cobbly silt loam, extremely gravelly clay loam.	GC	A-2, A-6	25-40	25-45	15-45	15-40	10-40	30-40	10-20
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
113D*: Waha------------	0-12	Silty clay loam	CL	A-6	0	100	95-100	90-100	85-95	30-40	10-20
	12-28	Silty clay loam, silt loam.	CL	A-6	0	100	95-100	95-100	85-95	30-40	10-20
	28-38	Very gravelly clay loam, very cobbly silt loam, extremely gravelly clay loam.	GC	A-2, A-6	25-40	25-45	15-45	15-40	10-40	30-40	10-20
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rockly-----------	0-6	Very cobbly loam	GM	A-2, A-4	40-60	50-75	45-70	35-65	25-50	25-30	NP-5
	6	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
114B, 114C, 115D, 115E, 116D, 117D------------ Walla Walla	0-6	Silt loam--------	ML	A-4	0	100	100	95-100	80-100	20-35	NP-10
	6-44	Silt loam--------	ML	A-4	0	100	100	95-100	80-100	20-35	NP-10
	44-60	Silt loam, silt	ML	A-4	0	100	100	95-100	80-100	20-35	NP-10
118B------------- Walla Walla	0-16	Silt loam--------	ML	A-4	0	100	100	95-100	80-100	20-35	NP-10
	16-57	Silt loam--------	ML	A-4	0	100	100	95-100	85-100	20-35	NP-10
	57	Indurated--------	---	---	---	---	---	---	---	---	---
119A------------- Wanser	0-14	Loamy fine sand	SM	A-2	0	100	100	75-85	15-35	---	NP
	14-60	Sand, fine sand, loamy fine sand.	SM	A-2	0	100	100	70-80	15-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
120C*:											
Wanser	0-14	Loamy fine sand	SM	A-2	0	100	100	75-85	15-35	---	NP
	14-60	Sand, fine sand, loamy fine sand.	SM	A-2	0	100	100	70-80	15-35	---	NP
Quincy	0-4	Fine sand	SM, SP-SM	A-2, A-3	0	100	100	75-90	5-20	---	NP
	4-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	10-30	---	NP
121B, 121C, 121D-- Willis	0-7	Silt loam	ML	A-4	0	100	100	90-100	70-80	---	NP
	7-27	Silt loam	ML	A-4	0	100	95-100	95-100	85-95	20-30	NP-5
	27-33	Silt loam	ML	A-4	0	95-100	95-100	95-100	80-90	20-30	NP-5
	33	Indurated	---	---	---	---	---	---	---	---	---
122B Winchester	0-10	Sand	SM	A-1, A-2	0-5	95-100	95-100	35-55	10-20	---	NP
	10-60	Coarse sand, sand	SP-SM, SP	A-1, A-3, A-2	0-5	95-100	95-100	30-55	0-10	---	NP
123B*:											
Winchester	0-10	Sand	SM	A-1, A-2	0-5	95-100	95-100	35-55	10-20	---	NP
	10-60	Coarse sand, sand	SP-SM, SP	A-1, A-3, A-2	0-5	95-100	95-100	30-55	0-10	---	NP
Quinton	0-29	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	29-35	Gravelly loamy fine sand, sand.	SM	A-1, A-2	0	75-100	65-100	40-80	10-30	---	NP
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
124B*:											
Winchester	0-10	Sand	SM	A-1, A-2	0-5	95-100	95-100	35-55	10-20	---	NP
	10-60	Coarse sand, sand	SP-SM, SP	A-1, A-3, A-2	0-5	95-100	95-100	30-55	0-10	---	NP
Urban land.											
125F*:											
Wrentham	0-10	Silt loam	ML	A-4	0-10	90-100	85-100	85-100	75-90	30-35	NP-5
	10-33	Extremely cobbly silt loam, extremely gravelly silt loam.	GM, ML	A-2, A-4	30-75	35-90	25-85	20-85	20-75	30-35	NP-5
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
126A. Xerofluvents											
127F. Xerollic Durorthids											
128A Yakima	0-10	Silt loam	ML	A-4	0	90-100	85-95	80-90	60-80	15-25	NP-5
	10-19	Gravelly silt loam.	ML	A-4	0	75-85	65-75	60-70	50-60	15-25	NP-5
	19-60	Very gravelly sand, extremely gravelly loamy sand, extremely gravelly sand.	GP, GP-GM	A-1	5-15	30-50	15-40	10-25	0-10	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
129A*:											
Yakima----------	0-10	Silt loam--------	ML	A-4	0	90-100	85-95	80-90	60-80	15-25	NP-5
	10-19	Gravelly silt loam.	ML	A-4	0	75-85	65-75	60-70	50-60	15-25	NP-5
	19-60	Very gravelly sand, extremely gravelly loamy sand, extremely gravelly sand.	GP, GP-GM	A-1	5-15	30-50	15-40	10-25	0-10	---	NP
Urban land.											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
1B, 1C------------ Adkins	0-4	4-8	1.15-1.30	0.6-2.0	0.14-0.17	6.6-7.8	<2	Low--------	0.32	5	3	.7-1
	4-35	4-8	1.20-1.50	0.6-2.0	0.14-0.17	6.6-7.8	<2	Low--------	0.37			
	35-60	4-8	1.40-1.70	0.6-2.0	0.14-0.17	7.9-9.0	<2	Low--------	0.37			
2B, 2C------------ Adkins	0-4	5-10	1.55-1.70	2.0-6.0	0.13-0.16	6.6-7.3	<2	Low--------	0.32	3	3	.8-1
	4-45	5-10	1.55-1.70	2.0-6.0	0.12-0.16	6.6-7.8	<2	Low--------	0.28			
	45-60	5-10	1.55-1.70	6.0-20	0.08-0.12	7.4-8.4	<2	Low--------	0.15			
3A, 3C------------ Adkins	0-12	5-10	1.55-1.70	2.0-6.0	0.13-0.16	6.6-9.0	<4	Low--------	0.32	3	3	.8-1
	12-60	5-10	1.55-1.70	2.0-6.0	0.13-0.16	6.6-9.0	<4	Low--------	0.37			
4B*:												
Adkins-----------	0-4	4-8	1.15-1.30	0.6-2.0	0.14-0.17	6.6-7.8	<2	Low--------	0.32	5	3	.7-1
	4-35	4-8	1.20-1.50	0.6-2.0	0.14-0.17	6.6-7.8	<2	Low--------	0.37			
	35-60	4-8	1.40-1.70	0.6-2.0	0.14-0.17	7.9-9.0	<2	Low--------	0.37			
Urban land.												
5C*:												
Albee------------	0-10	15-25	1.20-1.30	0.6-2.0	0.19-0.21	5.6-7.3	<2	Low--------	0.37	3	6	2-5
	10-19	15-25	1.20-1.30	0.6-2.0	0.17-0.19	5.6-7.3	<2	Low--------	0.43			
	19-28	20-35	1.30-1.45	0.6-2.0	0.15-0.18	5.6-7.3	<2	Moderate	0.24			
	28	---	---	---	---	---	---	-----------	----			
Bocker-----------	0-4	18-22	1.15-1.35	0.6-2.0	0.10-0.12	6.1-6.5	<2	Low--------	0.15	1	8	1-2
	4-7	20-24	1.30-1.50	0.6-2.0	0.09-0.11	6.1-7.3	<2	Low--------	0.20			
	7	---	---	---	---	---	---	-----------	----			
Anatone----------	0-4	10-20	1.20-1.30	0.6-2.0	0.09-0.11	6.1-7.3	<2	Low--------	0.10	1	8	2-3
	4-17	10-20	1.20-1.30	0.6-2.0	0.09-0.12	6.1-7.3	<2	Low--------	0.10			
	17	---	---	---	---	---	---	-----------	----			
6B, 6C, 6D, 6E--- Anderly	0-13	10-17	1.20-1.50	0.6-2.0	0.21-0.23	6.6-7.3	<2	Low--------	0.49	2	5	1-2
	13-24	10-17	1.20-1.50	0.6-2.0	0.21-0.23	7.4-7.8	<2	Low--------	0.64			
	24	---	---	---	---	---	---	-----------	----			
7C*:												
Anderly----------	0-13	10-17	1.20-1.50	0.6-2.0	0.21-0.23	6.6-7.3	<2	Low--------	0.49	2	5	1-2
	13-24	10-17	1.20-1.50	0.6-2.0	0.21-0.23	7.4-7.8	<2	Low--------	0.64			
	24	---	---	---	---	---	---	-----------	----			
Urban land.												
8B, 8C------------ Athena	0-26	15-20	1.10-1.30	0.6-2.0	0.19-0.21	6.1-7.3	<2	Low--------	0.37	5	---	2-4
	26-46	18-27	1.20-1.45	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.49			
	46-65	15-20	1.30-1.45	0.6-2.0	0.19-0.21	6.6-9.0	<2	Low--------	0.49			
9C---------------- Bocker	0-4	18-22	1.15-1.35	0.6-2.0	0.10-0.12	6.1-6.5	<2	Low--------	0.15	1	8	1-2
	4-7	20-24	1.30-1.50	0.6-2.0	0.09-0.11	6.1-7.3	<2	Low--------	0.20			
	7	---	---	---	---	---	---	-----------	----			
10D*:												
Bocker-----------	0-4	18-22	1.15-1.35	0.6-2.0	0.10-0.12	6.1-6.5	<2	Low--------	0.15	1	8	1-2
	4-7	20-24	1.30-1.50	0.6-2.0	0.09-0.11	6.1-7.3	<2	Low--------	0.20			
	7	---	---	---	---	---	---	-----------	----			
Bridgecreek------	0-16	20-27	1.20-1.40	0.6-2.0	0.19-0.23	6.1-7.3	<2	Low--------	0.43	2	6	1-3
	16-26	30-40	1.35-1.45	0.2-0.6	0.18-0.22	5.6-7.3	<2	Moderate	0.43			
	26-32	45-60	1.30-1.40	<0.06	0.14-0.17	6.1-7.3	<2	High-------	0.32			
	32	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
11F*:												
Bowlus----------	0-19	20-27	1.10-1.20	0.6-2.0	0.21-0.23	6.1-7.3	<2	Low--------	0.28	5	6	4-8
	19-42	20-35	1.10-1.30	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.43			
	42-60	28-35	1.20-1.35	0.6-2.0	0.11-0.23	5.6-7.3	<2	Moderate	0.20			
Buckcreek--------	0-11	15-27	1.20-1.40	0.6-2.0	0.18-0.22	6.1-7.3	<2	Low--------	0.32	2	6	3-5
	11-23	20-30	1.25-1.40	0.6-2.0	0.15-0.21	6.1-7.3	<2	Moderate	0.28			
	23-36	30-35	1.30-1.40	0.6-2.0	0.10-0.16	6.1-7.3	<2	Moderate	0.10			
	36	---	---	---	---	---	---	---------	----			
12C, 12E---------- Bridgecreek	0-16	20-27	1.20-1.40	0.6-2.0	0.19-0.23	6.1-7.3	<2	Low--------	0.43	2	6	1-3
	16-26	30-40	1.35-1.45	0.2-0.6	0.18-0.22	5.6-7.3	<2	Moderate	0.43			
	26-32	45-60	1.30-1.40	<0.06	0.14-0.17	6.1-7.3	<2	High------	0.32			
	32	---	---	---	---	---	---	---------	----			
13F*:												
Buckcreek--------	0-11	15-27	1.20-1.40	0.6-2.0	0.18-0.22	6.1-7.3	<2	Low--------	0.32	2	6	3-5
	11-23	20-30	1.25-1.40	0.6-2.0	0.15-0.21	6.1-7.3	<2	Moderate	0.28			
	23-36	30-35	1.30-1.40	0.6-2.0	0.10-0.16	6.1-7.3	<2	Moderate	0.10			
	36	---	---	---	---	---	---	---------	----			
Gwin------------	0-7	5-12	1.20-1.30	0.6-2.0	0.08-0.11	6.6-7.3	<2	Low--------	0.10	1	8	2-3
	7-13	27-35	1.20-1.40	0.2-0.6	0.07-0.11	6.6-7.3	<2	Low--------	0.05			
	13	---	---	---	---	---	---	---------	----			
14B-------------- Burbank	0-6	0-5	1.50-1.60	6.0-20	0.07-0.11	7.4-8.4	<2	Low--------	0.24	2	2	.5-1
	6-25	0-5	1.50-1.65	6.0-20	0.07-0.11	7.4-8.4	<2	Low--------	0.24			
	25-30	0-4	1.50-1.65	6.0-20	0.04-0.07	7.4-8.4	<2	Low--------	0.10			
	30-60	0-2	1.50-1.65	>20	0.01-0.03	7.4-8.4	<2	Low--------	0.05			
15B, 15C, 15E---- Burke	0-8	5-15	1.10-1.35	0.6-2.0	0.19-0.21	7.4-8.4	<2	Low--------	0.43	2	4L	1-2
	8-26	5-15	1.30-1.60	0.6-2.0	0.19-0.21	7.4-9.0	<2	Low--------	0.49			
	26	---	---	---	---	---	---	---------	----			
16B, 16C, 16D, 16E------------ Cantala	0-18	15-25	1.25-1.35	0.6-2.0	0.20-0.25	6.6-7.3	<2	Low--------	0.43	5	5	1-3
	18-54	18-25	1.30-1.40	0.6-2.0	0.20-0.25	6.6-7.3	<2	Low--------	0.49			
	54-60	18-27	1.30-1.40	0.6-2.0	0.18-0.25	7.4-7.8	<2	Low--------	0.49			
17A*:												
Catherine Variant--------	0-25	18-27	1.10-1.30	0.6-2.0	0.20-0.23	6.6-7.8	<2	Low--------	0.37	5	6	1-4
	25-60	18-25	1.30-1.50	0.6-2.0	0.07-0.10	6.6-7.3	<2	Low--------	0.37			
Catherine--------	0-25	18-27	1.25-1.35	0.6-2.0	0.19-0.21	6.1-7.3	<2	Low--------	0.28	5	---	4-10
	25-60	18-35	1.25-1.40	0.6-2.0	0.19-0.21	7.4-7.8	<2	Low--------	0.37			
18B, 18C, 18E, 19D, 20D-------- Condon	0-8	15-25	1.25-1.35	0.6-2.0	0.20-0.25	6.1-7.3	<2	Low--------	0.43	2	5	2-3
	8-30	18-27	1.30-1.40	0.6-2.0	0.19-0.21	6.1-7.8	<2	Low--------	0.43			
	30	---	---	---	---	---	---	---------	----			
21D*:												
Condon----------	0-8	15-25	1.25-1.35	0.6-2.0	0.20-0.25	6.1-7.3	<2	Low--------	0.43	2	5	2-3
	8-30	18-27	1.30-1.40	0.6-2.0	0.19-0.21	6.1-7.8	<2	Low--------	0.43			
	30	---	---	---	---	---	---	---------	----			
Bakeoven--------	0-3	15-25	1.25-1.35	0.2-0.6	0.06-0.09	6.1-7.8	<2	Low--------	0.15	1	---	1-3
	3-8	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	<2	Low--------	0.20			
	8	---	---	---	---	---	---	---------	----			
22C, 22D--------- Cowsly	0-5	14-27	1.00-1.20	0.6-2.0	0.19-0.21	6.1-7.3	<2	Low--------	0.43	5	---	1-2
	5-19	20-35	1.15-1.35	0.2-2.0	0.19-0.21	6.1-7.3	<2	Moderate	0.43			
	19-42	40-60	1.20-1.40	<0.06	0.14-0.16	6.1-7.3	<2	High------	0.28			
	42-60	27-45	1.25-1.45	0.2-0.6	0.09-0.15	6.1-7.3	<2	Moderate	0.20			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
23*. Dune land												
24B, 24C---------- Ellisforde	0-10	10-18	1.10-1.30	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low--------	0.49	5	5	1-2
	10-28	10-18	1.30-1.45	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.49			
	28-60	10-18	1.50-1.75	0.2-0.6	0.20-0.23	8.5-9.0	<2	Low--------	0.43			
25C*: Ellisforde-------	0-10	10-18	1.10-1.30	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low--------	0.49	5	5	1-2
	10-28	10-18	1.30-1.45	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.49			
	28-60	10-18	1.50-1.75	0.2-0.6	0.20-0.23	8.5-9.0	<2	Low--------	0.43			
Ellisforde, eroded----------	0-6	10-18	1.10-1.35	0.6-2.0	0.14-0.18	6.6-7.8	<2	Low--------	0.49	5	3	1-2
	6-22	10-18	1.30-1.45	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.49			
	22-60	10-18	1.50-1.75	0.2-0.6	0.20-0.23	8.5-9.0	<2	Low--------	0.43			
26E. Entic Durochrepts												
27A--------------- Esquatzel	0-9	2-6	1.10-1.30	0.6-2.0	0.19-0.23	6.6-8.4	<2	Low--------	0.43	5	5	1-2
	9-21	5-15	1.20-1.40	0.6-2.0	0.19-0.23	7.4-8.4	<2	Low--------	0.43			
	21-60	5-15	1.25-1.55	0.6-2.0	0.18-0.23	7.4-8.4	<2	Low--------	0.43			
28A--------------- Freewater	0-4	5-10	1.10-1.30	0.6-2.0	0.15-0.20	6.6-7.3	<2	Low--------	0.20	2	8	1-2
	4-20	8-15	1.10-1.30	0.6-2.0	0.09-0.14	6.6-7.3	<2	Low--------	0.15			
	20-60	0-8	1.60-1.70	>20.0	0.04-0.06	6.6-7.3	<2	Low--------	0.05			
29A--------------- Freewater	0-4	8-15	1.10-1.30	0.6-2.0	0.09-0.14	6.6-7.3	<2	Low--------	0.15	2	8	1-2
	4-20	8-15	1.10-1.30	0.6-2.0	0.09-0.14	6.6-7.3	<2	Low--------	0.15			
	20-60	0-8	1.60-1.70	>20.0	0.04-0.06	6.6-7.3	<2	Low--------	0.05			
30A*: Freewater--------	0-4	8-15	1.10-1.30	0.6-2.0	0.09-0.14	6.6-7.3	<2	Low--------	0.15	2	8	1-2
	4-20	8-15	1.10-1.30	0.6-2.0	0.09-0.14	6.6-7.3	<2	Low--------	0.15			
	20-60	0-8	1.60-1.70	>20.0	0.04-0.06	6.6-7.3	<2	Low--------	0.05			
Urban land.												
31B, 31D, 31E---- Gurdane	0-9	27-35	1.35-1.50	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.43	2	6	2-4
	9-20	27-35	1.35-1.45	0.2-0.6	0.18-0.22	6.1-7.3	<2	Moderate	0.37			
	20-30	40-50	1.30-1.40	<0.06	0.06-0.13	6.1-7.3	<2	High-------	0.15			
	30	---	---	---	---	---	---	-----------	----			
32E*: Gurdane----------	0-9	27-35	1.35-1.50	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.43	2	6	2-4
	9-20	27-35	1.35-1.45	0.2-0.6	0.18-0.22	6.1-7.3	<2	Moderate	0.37			
	20-30	40-50	1.30-1.40	<0.06	0.06-0.13	6.1-7.3	<2	High-------	0.15			
	30	---	---	---	---	---	---	-----------	----			
Gwinly------------	0-2	18-27	1.15-1.35	0.6-2.0	0.06-0.11	6.6-7.8	<2	Low--------	0.17	1	---	2-5
	2-7	27-40	1.15-1.35	0.2-0.6	0.06-0.11	6.6-7.3	<2	Moderate	0.17			
	7-15	40-50	1.20-1.30	0.06-0.2	0.05-0.10	6.6-7.3	<2	High-------	0.15			
	15	---	---	---	---	---	---	-----------	----			
33D*: Gurdane----------	0-9	27-35	1.35-1.50	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.43	2	6	2-4
	9-20	27-35	1.35-1.45	0.2-0.6	0.18-0.22	6.1-7.3	<2	Moderate	0.37			
	20-30	40-50	1.30-1.40	<0.06	0.06-0.13	6.1-7.3	<2	High-------	0.15			
	30	---	---	---	---	---	---	-----------	----			
Rockly------------	0-6	20-27	1.25-1.35	0.6-2.0	0.06-0.08	6.1-7.3	<2	Low--------	0.10	1	---	1-3
	6	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodi- bility group	Organic matter
									K	T		
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
34F*:												
Gwin------------	0-7	5-12	1.20-1.30	0.6-2.0	0.08-0.11	6.6-7.3	<2	Low--------	0.10	1	8	2-3
	7-13	27-35	1.20-1.40	0.2-0.6	0.07-0.11	6.6-7.3	<2	Low--------	0.05			
	13	---	---	---	---	---	---	-----------	-----			
Klicker----------	0-7	12-25	1.20-1.30	0.6-2.0	0.14-0.16	6.1-7.3	<2	Low--------	0.15	2	---	1-2
	7-21	18-27	1.20-1.30	0.6-2.0	0.10-0.14	6.1-6.5	<2	Low--------	0.10			
	21-26	18-35	1.25-1.40	0.2-0.6	0.10-0.13	6.1-6.5	<2	Moderate	0.15			
	26	---	---	---	---	---	---	-----------	-----			
Rock outcrop.												
35F*:												
Gwin------------	0-7	5-12	1.20-1.30	0.6-2.0	0.08-0.11	6.6-7.3	<2	Low--------	0.10	1	8	2-3
	7-13	27-35	1.20-1.40	0.2-0.6	0.07-0.11	6.6-7.3	<2	Low--------	0.05			
	13	---	---	---	---	---	---	-----------	-----			
Rock outcrop.												
36E--------------- Gwinly	0-2	18-27	1.15-1.35	0.6-2.0	0.06-0.11	6.6-7.8	<2	Low--------	0.17	1	---	2-5
	2-7	27-40	1.15-1.35	0.2-0.6	0.06-0.11	6.6-7.3	<2	Moderate	0.17			
	7-15	40-50	1.20-1.30	0.06-0.2	0.05-0.10	6.6-7.3	<2	High-------	0.15			
	15	---	---	---	---	---	---	-----------	-----			
37C, 37E---------- Hankins	0-9	20-27	1.10-1.30	0.6-2.0	0.20-0.23	5.6-7.3	<2	Low--------	0.28	4	---	3-5
	9-20	30-40	1.25-1.35	0.2-0.6	0.20-0.23	5.6-7.3	<2	Moderate	0.43			
	20-26	45-60	1.15-1.25	<0.06	0.14-0.18	6.6-7.3	<2	High-------	0.28			
	26-44	27-35	1.20-1.30	0.6-2.0	0.16-0.23	6.6-7.3	<2	Moderate	0.28			
	44	---	---	---	---	---	---	-----------	-----			
38C, 38E---------- Helter	0-6	3-10	0.75-0.85	0.6-2.0	0.24-0.38	5.6-7.3	<2	Low--------	0.49	5	---	1-3
	6-33	3-10	0.75-0.85	0.6-2.0	0.24-0.38	5.6-7.3	<2	Low--------	0.55			
	33-40	10-30	1.00-1.35	0.2-0.6	0.18-0.21	5.1-7.3	<2	Moderate	0.49			
	40-60	10-35	1.10-1.40	0.2-0.6	0.16-0.18	5.1-6.5	<2	Moderate	0.20			
39A--------------- Hermiston	0-24	10-18	1.25-1.35	0.6-2.0	0.19-0.21	6.6-8.4	<2	Low--------	0.37	5	5	1-3
	24-60	10-18	1.30-1.50	0.6-2.0	0.17-0.20	>7.3	<2	Low--------	0.49			
40C, 40E---------- Kahler	0-23	15-25	1.15-1.25	0.6-2.0	0.13-0.20	6.6-7.3	<2	Low--------	0.37	3	---	1-3
	23-35	20-30	1.20-1.30	0.6-2.0	0.13-0.20	6.6-7.3	<2	Low--------	0.20			
	35-50	18-25	1.20-1.30	0.6-2.0	0.13-0.17	6.6-7.3	<2	Low--------	0.20			
	50	---	---	---	---	---	---	-----------	-----			
41F--------------- Kahler	0-12	15-25	1.20-1.30	0.6-2.0	0.13-0.17	5.6-7.3	<2	Low--------	0.17	4	6	3-5
	12-22	15-25	1.20-1.30	0.6-2.0	0.13-0.19	5.6-7.3	<2	Low--------	0.24			
	22-45	20-30	1.30-1.40	0.6-2.0	0.10-0.13	5.6-7.3	<2	Low--------	0.10			
	45	---	---	---	---	---	---	-----------	-----			
42A--------------- Kimberly	0-10	5-10	1.25-1.35	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.32	5	3	1-2
	10-26	5-15	1.30-1.40	2.0-6.0	0.11-0.15	6.6-9.0	<2	Low--------	0.28			
	26-60	5-10	1.40-1.60	2.0-6.0	0.10-0.15	7.9-9.0	<2	Low--------	0.28			
43A--------------- Kimberly	0-10	10-18	1.25-1.35	2.0-6.0	0.15-0.17	6.6-7.8	<2	Low--------	0.37	5	4L	1-2
	10-26	5-15	1.30-1.40	2.0-6.0	0.11-0.15	6.6-9.0	<2	Low--------	0.28			
	26-60	5-10	1.40-1.60	2.0-6.0	0.10-0.15	7.9-9.0	<2	Low--------	0.28			
44D--------------- Klicker	0-7	10-20	1.15-1.35	0.6-2.0	0.18-0.20	6.1-6.5	<2	Low--------	0.32	2	---	2-5
	7-21	25-35	1.20-1.40	0.2-0.6	0.11-0.15	6.1-7.3	<2	Moderate	0.15			
	21	---	---	---	---	---	---	-----------	-----			
45E--------------- Klicker	0-7	12-25	1.20-1.30	0.6-2.0	0.14-0.16	6.1-7.3	<2	Low--------	0.15	2	---	1-2
	7-21	18-27	1.20-1.30	0.6-2.0	0.10-0.14	6.1-6.5	<2	Low--------	0.10			
	21-26	18-35	1.25-1.40	0.2-0.6	0.10-0.13	6.1-6.5	<2	Moderate	0.15			
	26	---	---	---	---	---	---	-----------	-----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodi- bility group	Organic matter
									K	T		
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
46C*, 46E*:												
Klicker----------	0-7	10-20	1.15-1.35	0.6-2.0	0.18-0.20	6.1-6.5	<2	Low--------	0.32	2	---	2-5
	7-21	25-35	1.20-1.40	0.2-0.6	0.11-0.15	6.1-7.3	<2	Moderate	0.15			
	21	---	---	---	---	---	---	-----------	----			
Anatone----------	0-5	10-20	1.20-1.30	0.6-2.0	0.09-0.11	6.1-7.3	<2	Low--------	0.10	1	8	2-3
	5-12	10-20	1.20-1.30	0.6-2.0	0.09-0.12	6.1-7.3	<2	Low--------	0.10			
	12	---	---	---	---	---	---	-----------	----			
Bocker-----------	0-4	18-22	1.15-1.35	0.6-2.0	0.10-0.12	6.1-6.5	<2	Low--------	0.15	1	8	1-2
	4-7	20-24	1.30-1.50	0.6-2.0	0.09-0.11	6.1-7.3	<2	Low--------	0.20			
	7	---	---	---	---	---	---	-----------	----			
47B-------------- Koehler	0-11	0-5	1.40-1.60	6.0-20	0.09-0.11	7.4-8.4	<2	Low--------	0.20	2	2	.5-1
	11-24	0-5	1.40-1.60	6.0-20	0.08-0.10	7.9-8.4	<2	Low--------	0.20			
	24	---	---	---	---	---	---	-----------	----			
48E-------------- Lickskillet	0-2	15-25	1.25-1.35	0.6-2.0	0.08-0.14	6.1-7.3	<2	Low--------	0.20	1	---	1-2
	2-18	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-8.4	<2	Low--------	0.17			
	18	---	---	---	---	---	---	-----------	----			
49F*:												
Lickskillet------	0-2	15-25	1.25-1.35	0.6-2.0	0.08-0.14	6.1-7.3	<2	Low--------	0.20	1	---	1-2
	2-18	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-8.4	<2	Low--------	0.17			
	18	---	---	---	---	---	---	-----------	----			
Nansene----------	0-20	10-18	1.25-1.35	0.6-2.0	0.16-0.19	6.1-7.8	<2	Low--------	0.43	5	---	1-3
	20-60	10-18	1.30-1.40	0.6-2.0	0.16-0.19	6.1-7.8	<2	Low--------	0.55			
	45-60	10-18	1.30-1.40	0.6-2.0	0.16-0.19	6.6-8.4	<2	Low--------	0.55			
50F*:												
Lickskillet------	0-2	15-25	1.25-1.35	0.6-2.0	0.08-0.14	6.1-7.3	<2	Low--------	0.15	1	---	1-2
	2-18	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-8.4	<2	Low--------	0.17			
	18	---	---	---	---	---	---	-----------	----			
Rock outcrop.												
51A, 52D, 53D---- McKay	0-14	15-20	1.20-1.40	0.6-2.0	0.20-0.22	5.6-7.8	<2	Low--------	0.43	3	6	2-3
	14-25	27-35	1.50-1.70	0.06-0.2	0.14-0.16	>7.3	<4	Moderate	0.37			
	25-60	25-35	1.30-1.40	0.2-0.6	0.08-0.13	7.9-9.0	<4	Moderate	0.20			
54B, 54C, 54D, 54E-------------- Mikkalo	0-16	8-12	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43	2	5	1-2
	16-38	8-12	1.25-1.40	0.6-2.0	0.18-0.20	7.4-9.0	<2	Low--------	0.49			
	38	---	---	---	---	---	---	-----------	----			
55A-------------- Mondovi	0-10	10-15	1.10-1.30	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.37	5	5	2-4
	10-60	10-18	1.20-1.35	0.6-2.0	0.19-0.21	7.4-7.8	<2	Low--------	0.32			
56B, 56C, 56E, 57D, 58D--------- Morrow	0-10	18-25	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	<2	Low--------	0.37	2	---	1-2
	10-15	24-35	1.30-1.40	0.2-0.6	0.19-0.21	6.6-7.8	<2	Moderate	0.43			
	15-27	18-30	1.30-1.50	0.6-2.0	0.19-0.21	7.9-8.4	<2	Low--------	0.43			
	27	---	---	---	---	---	---	-----------	----			
59D*:												
Morrow-----------	0-10	18-25	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.3	<2	Low--------	0.37	2	---	1-2
	10-15	24-35	1.30-1.40	0.2-0.6	0.19-0.21	6.6-7.8	<2	Moderate	0.43			
	15-27	18-30	1.30-1.50	0.6-2.0	0.19-0.21	7.9-8.4	<2	Low--------	0.43			
	27	---	---	---	---	---	---	-----------	----			
Bakeoven---------	0-3	15-25	1.25-1.35	0.2-0.6	0.06-0.09	6.1-7.8	<2	Low--------	0.15	1	---	1-3
	3-8	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	<2	Low--------	0.20			
	8	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
60F: Nansene	0-20	10-18	1.25-1.35	0.6-2.0	0.16-0.19	6.1-7.8	<2	Low	0.43	5	---	1-3
	20-60	10-18	1.30-1.40	0.6-2.0	0.16-0.19	6.1-7.8	<2	Low	0.55			
	45-60	10-18	1.30-1.40	0.6-2.0	0.16-0.19	6.6-8.4	<2	Low	0.55			
61A, 61C, 62C: Oliphant	0-9	12-18	1.15-1.35	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low	0.43	3	5	3-4
	9-16	12-18	1.30-1.45	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low	0.43			
	16-26	12-18	1.30-1.45	0.6-2.0	0.19-0.21	7.4-8.4	<2	Low	0.43			
	26-41	12-18	1.30-1.45	0.6-2.0	0.18-0.20	7.9-8.4	<2	Low	0.43			
	41-60	12-18	1.30-1.50	0.6-2.0	0.09-0.12	7.9-9.0	<2	Low	0.17			
63A: Onyx	0-12	10-15	1.15-1.30	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low	0.43	5	5	2-3
	12-60	10-18	1.25-1.35	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low	0.43			
64B, 64C, 64D, 64E: Palouse	0-27	18-24	1.10-1.30	0.6-2.0	0.19-0.21	6.6-7.3	<2	Low	0.32	5	5	2-4
	27-60	20-30	1.20-1.45	0.6-2.0	0.19-0.21	6.1-7.8	<2	Moderate	0.43			
65A: Pedigo	0-21	3-7	1.30-1.45	6.0-2.0	0.11-0.15	>8.4	<4	Low	0.17	5	2	1-2
	21-60	10-18	1.25-1.45	0.6-2.0	0.19-0.21	7.9-9.0	<4	Low	0.37			
66A: Pedigo	0-21	10-15	1.10-1.40	0.6-2.0	0.15-0.20	>8.4	<4	Low	0.37	5	4L	2-4
	21-60	10-18	1.10-1.55	0.6-2.0	0.15-0.20	7.9-9.0	<4	Low	0.37			
67B, 67C, 68D, 68E, 69D, 69E: Pilot Rock	0-10	10-18	1.30-1.50	0.6-2.0	0.21-0.23	6.6-7.3	<2	Low	0.43	2	5	1-3
	10-27	10-18	1.30-1.50	0.6-2.0	0.17-0.19	7.4-9.0	<2	Low	0.49			
	27-45	---	---	---	---	---	---	---	---			
	45-60	0-5	1.50-1.70	>20	0.02-0.04	8.5-9.0	<2	Low	0.05			
70*. Pits												
71A: Potamus	0-4	20-27	1.20-1.30	0.6-2.0	0.13-0.17	6.1-7.3	<2	Low	0.15	5	6	2-4
	4-15	25-30	1.20-1.30	0.6-2.0	0.13-0.20	6.1-7.3	<2	Moderate	0.17			
	15-60	27-35	1.20-1.40	0.6-2.0	0.07-0.16	6.1-7.3	<2	Moderate	0.10			
72A: Powder	0-15	10-18	1.25-1.35	0.6-2.0	0.18-0.25	6.6-8.4	<2	Low	0.37	5	---	1-3
	15-27	10-18	1.30-1.40	0.6-2.0	0.18-0.25	6.6-8.4	<2	Low	0.37			
	27-60	10-18	1.40-1.60	0.6-2.0	0.18-0.25	6.6-8.4	<2	Low	0.37			
73D, 73E: Prosser	0-4	5-12	1.15-1.25	0.6-2.0	0.16-0.20	6.6-7.8	<2	Low	0.43	2	5	1-2
	4-24	5-12	1.30-1.45	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low	0.49			
	24-30	5-12	1.30-1.50	0.6-2.0	0.10-0.17	7.9-8.4	<2	Low	0.49			
	30	---	---	---	---	---	---	---	---			
74B: Quincy	0-4	1-6	1.35-1.50	6.0-20	0.08-0.11	6.1-8.4	<2	Low	0.17	5	1	.5-1
	4-60	1-7	1.45-1.60	6.0-20	0.06-0.09	6.6-8.4	<2	Low	0.17			
75B, 75E: Quincy	0-4	1-6	1.30-1.45	6.0-20	0.11-0.15	6.1-8.4	<2	Low	0.17	5	2	.5-1
	4-60	1-7	1.45-1.60	6.0-20	0.06-0.09	6.6-8.4	<2	Low	0.17			
76B: Quincy	0-4	0-5	1.30-1.45	6.0-20.0	0.09-0.10	6.6-7.8	<2	Low	0.17	3	2	.8-1
	4-41	0-5	1.45-1.60	6.0-20.0	0.05-0.09	6.6-8.4	<2	Low	0.17			
	41-60	0-5	1.45-1.60	6.0-20.0	0.04-0.08	7.9-8.4	<2	Low	0.02			
77C: Quincy	0-4	1-6	1.30-1.45	6.0-20	0.11-0.15	6.1-8.4	<2	Low	0.17	5	2	.5-1
	4-60	1-7	1.45-1.60	6.0-20	0.06-0.09	6.6-8.4	<2	Low	0.17			
78B*: Quincy	0-4	1-6	1.35-1.50	6.0-20	0.08-0.11	6.1-8.4	<2	Low	0.17	5	1	.5-1
	4-60	1-7	1.45-1.60	6.0-20	0.06-0.09	6.6-8.4	<2	Low	0.17			
Rock outcrop.												

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
79B, 79C, 79D, 79E------------- Ritzville	0-9	5-10	1.15-1.35	0.6-2.0	0.15-0.18	6.6-7.8	<2	Low--------	0.49	5	3	1-2
	9-36	5-10	1.20-1.40	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43			
	36-60	5-10	1.30-1.45	0.6-2.0	0.19-0.21	7.9-9.0	<2	Low--------	0.43			
80B, 80C, 80D, 81E, 82E-------- Ritzville	0-5	5-10	1.10-1.30	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43	5	5	1-2
	5-36	5-10	1.20-1.40	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43			
	36-60	5-10	1.30-1.45	0.6-2.0	0.19-0.21	7.9-9.0	<2	Low--------	0.43			
83C*: Ritzville--------	0-5	5-10	1.10-1.30	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43	5	5	1-2
	5-36	5-10	1.20-1.40	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43			
	36-60	5-10	1.30-1.45	0.6-2.0	0.19-0.21	7.9-9.0	<2	Low--------	0.43			
Rock outcrop.												
84*. Riverwash												
85F*: Rock outcrop.												
Xeric Torriorthents.												
86D-------------- Rockly	0-6	20-27	1.25-1.35	0.6-2.0	0.06-0.08	6.1-7.3	<2	Low--------	0.10	1	---	1-3
	6	---	---	---	---	---	---	-----------	----			
87B, 87C--------- Sagehill	0-8	2-8	1.20-1.40	2.0-6.0	0.18-0.20	6.6-8.4	<2	Low--------	0.32	5	3	.5-1
	8-27	2-8	1.30-1.55	2.0-6.0	0.18-0.20	6.6-8.4	<2	Low--------	0.49			
	27-60	2-8	1.30-1.60	0.6-2.0	0.18-0.20	7.9-9.0	<2	Low--------	0.55			
88B, 88C, 88D---- Shano	0-13	5-10	1.20-1.35	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low--------	0.55	5	3	1-2
	13-28	5-10	1.30-1.45	0.6-2.0	0.18-0.20	7.4-8.4	<2	Low--------	0.49			
	28-60	5-10	1.30-1.45	0.6-2.0	0.18-0.20	7.4-9.0	<2	Low--------	0.49			
89B, 89C, 89D, 89E------------- Shano	0-6	5-10	1.15-1.30	0.6-2.0	0.18-0.20	6.6-8.4	<2	Low--------	0.43	5	5	1-2
	6-18	5-10	1.30-1.45	0.6-2.0	0.18-0.20	7.4-8.4	<2	Low--------	0.49			
	18-65	5-10	1.30-1.45	0.6-2.0	0.18-0.20	7.4-9.0	<2	Low--------	0.49			
90A*: Silvies----------	0-15	18-27	1.00-1.10	0.6-2.0	0.21-0.23	6.6-7.3	<2	Moderate	0.17	---	---	---
	15-35	35-60	1.10-1.30	0.06-0.2	0.13-0.21	6.6-7.3	<2	High-------	0.20			
	35-60	45-60	1.10-1.30	0.06-0.2	0.13-0.16	6.6-7.3	<2	High-------	0.24			
Winom-----------	0-13	30-40	1.20-1.30	0.2-0.6	0.20-0.23	6.1-7.3	<2	Moderate	0.37	5	7	3-5
	13-28	45-60	1.10-1.30	<0.06	0.15-0.18	6.6-7.3	<2	High-------	0.28			
	28-60	35-60	1.10-1.30	<0.06	0.15-0.17	6.6-8.4	<2	High-------	0.37			
91A-------------- Stanfield	0-6	10-18	1.25-1.35	0.6-2.0	0.13-0.17	>7.8	<4	Low--------	0.43	3	4L	.8-2
	6-22	10-18	1.30-1.50	0.6-2.0	0.13-0.21	>7.8	<4	Low--------	0.37			
	22-70	---	---	<0.06	---	>7.8	<4	Low--------	----			
	70-86	10-18	1.30-1.40	0.6-2.0	0.13-0.21	>7.3	<4	Low--------	0.43			
92A-------------- Stanfield	0-6	10-15	1.25-1.35	0.6-2.0	0.23-0.29	7.9-8.4	<2	Low--------	0.55	2	4L	1-2
	6-30	10-15	1.30-1.50	0.6-2.0	0.22-0.28	7.9-9.0	<4	Low--------	0.64			
	30	---	---	---	---	---	---	-----------	----			
93B-------------- Starbuck	0-10	5-10	1.20-1.35	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43	1	3	.5-1
	10-18	5-15	1.30-1.45	0.6-2.0	0.12-0.15	6.6-7.8	<2	Low--------	0.28			
	18	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
94A*:												
Starbuck--------	0-10	5-10	1.20-1.35	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43	1	3	.5-1
	10-18	5-15	1.30-1.45	0.6-2.0	0.12-0.15	6.6-7.8	<2	Low--------	0.28			
	18	---	---	---	---	---	---	-----------	----			
Rock outcrop.												
95B-------------- Taunton	0-6	5-8	1.20-1.40	2.0-6.0	0.14-0.16	7.4-8.4	<2	Low--------	0.32	2	3	1-2
	6-11	5-12	1.30-1.50	0.6-2.0	0.15-0.18	7.4-9.0	<2	Low--------	0.49			
	11-26	5-12	1.30-1.50	0.6-2.0	0.10-0.14	7.4-9.0	<2	Low--------	0.24			
	26	---	---	---	---	---	---	-----------	----			
96B, 96D--------- Thatuna	0-37	10-20	1.10-1.20	0.6-2.0	0.19-0.21	5.6-7.3	<2	Low--------	0.32	5	---	3-6
	37-60	24-35	1.60-1.70	0.06-0.2	0.19-0.21	6.1-7.3	<2	Moderate	0.55			
97C-------------- Tolo	0-33	5-15	0.70-0.85	0.6-2.0	0.24-0.38	5.6-7.3	<2	Low--------	0.43	5	---	2-5
	33-60	18-35	1.10-1.45	0.2-0.6	0.15-0.24	5.6-7.3	<2	Moderate	0.49			
	60-70	30-35	1.20-1.40	0.2-0.6	0.10-0.14	5.6-7.3	<2	Moderate	0.24			
97E-------------- Tolo	0-4	5-15	0.70-0.85	0.6-2.0	0.24-0.38	5.6-7.3	<2	Low--------	0.43	5	---	2-5
	4-22	18-35	1.10-1.45	0.2-0.6	0.15-0.24	5.6-7.3	<2	Moderate	0.49			
	22-60	30-35	1.20-1.40	0.2-0.6	0.10-0.14	5.6-7.3	<2	Moderate	0.24			
98C, 98E--------- Tolo	0-12	5-15	0.70-0.85	0.6-2.0	0.24-0.30	5.6-7.3	<2	Low--------	0.43	5	5	2-5
	12-31	5-15	0.70-0.85	0.6-2.0	0.24-0.30	5.6-7.3	<2	Low--------	0.43			
	31-60	18-30	0.95-1.20	0.2-0.6	0.08-0.10	5.6-7.3	<2	Moderate	0.17			
99C*, 99E*:												
Tolo------------	0-12	5-15	0.70-0.85	0.6-2.0	0.24-0.30	5.6-7.3	<2	Low--------	0.43	5	5	2-5
	12-31	5-15	0.70-0.85	0.6-2.0	0.24-0.30	5.6-7.3	<2	Low--------	0.43			
	31-60	18-30	0.95-1.20	0.2-0.6	0.08-0.10	5.6-7.3	<2	Moderate	0.17			
Kilmerque-------	0-4	10-20	1.00-1.20	0.6-2.0	0.14-0.17	6.1-7.3	<2	Low--------	0.24	2	---	3-5
	4-12	10-18	1.00-1.20	0.6-2.0	0.11-0.15	6.1-7.3	<2	Low--------	0.20			
	12-32	5-15	1.20-1.40	2.0-6.0	0.07-0.10	6.1-7.3	<2	Low--------	0.15			
	32	---	---	---	---	---	---	-----------	----			
100C*, 100E*:												
Tolo------------	0-4	5-15	0.70-0.85	0.6-2.0	0.24-0.38	5.6-7.3	<2	Low--------	0.43	5	---	2-5
	4-22	18-35	1.10-1.45	0.2-0.6	0.15-0.24	5.6-7.3	<2	Moderate	0.49			
	22-60	30-35	1.20-1.40	0.2-0.6	0.10-0.14	5.6-7.3	<2	Moderate	0.24			
Klicker---------	0-7	10-20	1.15-1.35	0.6-2.0	0.18-0.20	6.1-6.5	<2	Low--------	0.32	2	---	2-5
	7-21	25-35	1.20-1.40	0.2-0.6	0.11-0.15	6.1-7.3	<2	Moderate	0.15			
	21	---	---	---	---	---	---	-----------	----			
101A------------- Tolo Variant	0-14	15-20	0.75-0.85	0.6-2.0	0.25-0.34	5.6-6.5	<2	Low--------	0.20	5	---	5-10
	14-26	10-20	0.75-0.85	0.6-2.0	0.25-0.34	6.1-7.3	<2	Low--------	0.43			
	26-60	15-25	1.00-1.20	0.6-2.0	0.21-0.25	6.1-7.3	<2	Low--------	0.49			
102C, 103E, 104E- Tutuilla	0-19	27-35	1.20-1.30	0.2-0.6	0.20-0.23	6.1-7.3	<2	Moderate	0.37	3	7	2-4
	19-35	50-60	1.20-1.50	0.06-0.2	0.14-0.16	6.1-7.3	<2	High-------	0.32			
	35-50	35-60	1.30-1.50	0.06-0.2	0.14-0.16	6.1-7.3	<2	High-------	0.32			
	50	---	---	---	---	---	---	-----------	----			
105A, 106A------- Umapine	0-7	10-15	1.15-1.35	0.6-2.0	0.18-0.20	>8.4	2-4	Low--------	0.43	5	4L	.5-1
	7-60	10-20	1.20-1.40	0.6-2.0	0.18-0.21	>7.3	2-4	Low--------	0.43			
107E*, 107F*:												
Umatilla--------	0-12	17-27	1.10-1.30	0.6-2.0	0.16-0.19	5.6-7.3	<2	Low--------	0.28	5	6	3-5
	12-28	20-35	1.25-1.40	0.6-2.0	0.13-0.20	5.6-7.3	<2	Moderate	0.24			
	28-60	30-40	1.30-1.40	0.6-2.0	0.10-0.16	5.6-7.3	<2	Moderate	0.10			
Kahler----------	0-8	15-27	1.25-1.35	0.6-2.0	0.13-0.20	5.6-7.3	<2	Low--------	0.37	5	---	1-4
	8-22	20-30	1.25-1.35	0.6-2.0	0.15-0.21	5.6-7.3	<2	Moderate	0.37			
	22-64	18-35	1.30-1.40	0.6-2.0	0.13-0.20	5.6-7.3	<2	Moderate	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
108F*:												
Umatilla--------	0-7	17-27	1.10-1.30	0.6-2.0	0.16-0.19	5.6-7.3	<2	Low--------	0.28	5	6	3-5
	7-13	20-35	1.25-1.40	0.6-2.0	0.13-0.20	5.6-7.3	<2	Moderate	0.24			
	13-60	30-40	1.30-1.40	0.6-2.0	0.10-0.16	5.6-7.3	<2	Moderate	0.10			
Kahler----------	0-8	15-27	1.25-1.35	0.6-2.0	0.13-0.20	5.6-7.3	<2	Low--------	0.37	5	---	1-4
	8-22	20-30	1.25-1.35	0.6-2.0	0.15-0.21	5.6-7.3	<2	Moderate	0.37			
	22-64	18-35	1.30-1.40	0.6-2.0	0.13-0.20	5.6-7.3	<2	Moderate	0.37			
Gwin------------	0-5	5-12	1.20-1.30	0.6-2.0	0.08-0.11	6.6-7.3	<2	Low--------	0.10	1	8	2-3
	5-14	27-35	1.20-1.40	0.2-0.6	0.07-0.11	6.6-7.3	<2	Low--------	0.05			
	14	---	---	---	---	---	---	-----------	----			
109A------------- Veazie	0-18	10-18	1.30-1.40	0.6-2.0	0.16-0.21	6.1-7.3	<2	Low--------	0.37	2	---	2-3
	18-60	0-3	1.50-1.70	>20	0.03-0.05	6.6-7.3	<2	Low--------	0.10			
110A------------- Veazie	0-18	10-18	1.40-1.50	0.6-2.0	0.10-0.15	6.1-7.3	<2	Low--------	0.20	2	---	2-3
	18-60	0-3	1.50-1.70	>20	0.03-0.05	6.6-7.3	<2	Low--------	0.10			
111A. Vitrandepts												
112B------------- Waha	0-13	27-30	1.20-1.30	0.2-0.6	0.18-0.21	6.1-6.5	<2	Moderate	0.32	2	---	2-3
	13-23	20-32	1.25-1.35	0.2-0.6	0.18-0.21	6.6-7.3	<2	Moderate	0.37			
	23-28	25-35	1.25-1.35	0.2-0.6	0.06-0.09	6.6-7.3	<2	Moderate	0.10			
	28	---	---	---	---	---	---	-----------	----			
112D, 112E------- Waha	0-12	27-30	1.20-1.30	0.2-0.6	0.18-0.21	6.1-6.5	<2	Moderate	0.32	2	---	2-3
	12-28	20-32	1.25-1.35	0.2-0.6	0.18-0.21	6.6-7.3	<2	Moderate	0.37			
	28-38	25-35	1.25-1.35	0.2-0.6	0.06-0.09	6.6-7.3	<2	Moderate	0.10			
	38	---	---	---	---	---	---	-----------	----			
113D*:												
Waha------------	0-12	27-30	1.20-1.30	0.2-0.6	0.18-0.21	6.1-6.5	<2	Moderate	0.32	2	---	2-3
	12-28	20-32	1.25-1.35	0.2-0.6	0.18-0.21	6.6-7.3	<2	Moderate	0.37			
	28-38	25-35	1.25-1.35	0.2-0.6	0.06-0.09	6.6-7.3	<2	Moderate	0.10			
	38	---	---	---	---	---	---	-----------	----			
Rockly----------	0-6	20-27	1.25-1.35	0.6-2.0	0.06-0.08	6.1-7.3	<2	Low--------	0.10	1	---	1-3
	6	---	---	---	---	---	---	-----------	----			
114B, 114C, 115D, 115E, 116D, 117D------------ Walla Walla	0-6	10-18	1.10-1.30	0.6-2.0	0.17-0.20	6.6-7.8	<2	Low--------	0.43	5	5	2-3
	6-44	10-18	1.20-1.45	0.6-2.0	0.17-0.20	6.6-7.8	<2	Low--------	0.55			
	44-60	10-18	1.30-1.45	0.6-2.0	0.16-0.19	7.4-9.0	<2	Low--------	0.55			
118B------------- Walla Walla	0-16	10-18	1.10-1.30	0.6-2.0	0.17-0.20	6.6-7.8	<2	Low--------	0.43	3	5	2-3
	16-57	10-18	1.25-1.45	0.6-2.0	0.17-0.20	7.4-9.0	<2	Low--------	0.49			
	57	---	---	---	---	---	---	-----------	----			
119A------------- Wanser	0-14	0-3	1.40-1.60	6.0-20	0.10-0.12	7.9-9.0	<4	Low--------	0.32	5	2	.2-.4
	14-60	0-3	1.40-1.60	6.0-20	0.06-0.09	7.9-9.0	2-4	Low--------	0.24			
120C*:												
Wanser----------	0-14	0-3	1.40-1.60	6.0-20	0.10-0.12	7.9-9.0	<4	Low--------	0.32	5	2	.2-.4
	14-60	0-3	1.40-1.60	6.0-20	0.06-0.09	7.9-9.0	2-4	Low--------	0.24			
Quincy----------	0-4	1-6	1.35-1.50	6.0-20	0.08-0.11	6.1-8.4	<2	Low--------	0.17	5	1	.5-1
	4-60	1-7	1.45-1.60	6.0-20	0.06-0.09	6.6-8.4	<2	Low--------	0.17			
121B, 121C, 121D- Willis	0-7	5-10	1.15-1.35	0.6-2.0	0.19-0.21	6.6-7.8	<2	Low--------	0.43	2	5	1-2
	7-27	10-15	1.30-1.45	0.6-2.0	0.18-0.21	7.4-8.4	<2	Low--------	0.49			
	27-33	10-15	1.30-1.45	0.6-2.0	0.18-0.20	7.9-9.0	<2	Low--------	0.49			
	33	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
122B------------- Winchester	0-10	0-5	1.50-1.70	6.0-20	0.05-0.07	6.1-8.4	<2	Low--------	0.10	5	1	.5-1
	10-60	0-5	1.50-1.70	6.0-20	0.05-0.07	6.6-8.4	<2	Low--------	0.15			
123B*:												
Winchester------	0-10	0-5	1.50-1.70	6.0-20	0.05-0.07	6.1-8.4	<2	Low--------	0.10	5	1	.5-1
	10-60	0-5	1.50-1.70	6.0-20	0.05-0.07	6.6-8.4	<2	Low--------	0.15			
Quinton----------	0-29	0-5	1.40-1.70	6.0-20	0.08-0.09	6.6-8.4	<2	Low--------	0.17	2	2	<.8
	29-35	0-5	1.40-1.70	6.0-20	0.05-0.08	6.6-8.4	<2	Low--------	0.10			
	35	---	---	---	---	---	---	-----------	-----			
124B*:												
Winchester------	0-10	0-5	1.50-1.70	6.0-20	0.05-0.07	6.1-8.4	<2	Low--------	0.10	5	1	.5-1
	10-60	0-5	1.50-1.70	6.0-20	0.05-0.07	6.6-8.4	<2	Low--------	0.15			
Urban land.												
125F*:												
Wrentham---------	0-10	15-25	1.25-1.35	0.6-2.0	0.15-0.21	6.1-7.3	<2	Low--------	0.37	2	---	3-5
	10-33	18-35	1.30-1.40	0.2-0.6	0.09-0.14	6.6-7.3	<2	Low--------	0.10			
	33	---	---	---	---	---	---	-----------	-----			
Rock outcrop.												
126A. Xerofluvents												
127F. Xerollic Durorthids												
128A------------- Yakima	0-10	5-12	1.10-1.30	0.6-2.0	0.19-0.23	6.1-7.8	<2	Low--------	0.37	2	5	2-3
	10-19	5-10	1.10-1.35	0.6-2.0	0.18-0.22	6.1-7.8	<2	Low--------	0.32			
	19-60	0-5	1.45-1.75	>20	0.03-0.04	6.1-7.8	<2	Low--------	0.10			
129A*:												
Yakima-----------	0-10	5-12	1.10-1.30	0.6-2.0	0.19-0.23	6.1-7.8	<2	Low--------	0.37	2	5	2-3
	10-19	5-10	1.10-1.35	0.6-2.0	0.18-0.22	6.1-7.8	<2	Low--------	0.32			
	19-60	0-5	1.45-1.75	>20	0.03-0.04	6.1-7.8	<2	Low--------	0.10			
Urban land.												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL FEATURES

[The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Thickness		Uncoated steel	Concrete
	In		In				
1B, 1C Adkins	>60	---	---	---	Moderate	High	Low.
2B, 2C, 3A, 3C Adkins	>60	---	---	---	Moderate	High	Low.
4B*:							
Adkins	>60	---	---	---	Moderate	High	Low.
Urban land.							
5C*:							
Albee	20-40	Hard	---	---	High	Moderate	Moderate.
Bocker	4-10	Hard	---	---	Moderate	Moderate	Low.
Anatone	10-20	Hard	---	---	Moderate	Moderate	Low.
6B, 6C, 6D, 6E Anderly	20-40	Hard	---	---	High	Moderate	Low.
7C*:							
Anderly	20-40	Hard	---	---	High	Moderate	Low.
Urban land.							
8B, 8C Athena	>60	---	---	---	High	High	Low.
9C Bocker	4-10	Hard	---	---	Moderate	Moderate	Low.
10D*:							
Bocker	4-10	Hard	---	---	Moderate	Moderate	Low.
Bridgecreek	20-40	Soft	---	---	High	Moderate	Moderate.
11F*:							
Bowlus	>60	---	---	---	High	Moderate	Moderate.
Buckcreek	20-40	Hard	---	---	Moderate	Moderate	Low.
12C, 12E Bridgecreek	20-40	Soft	---	---	High	Moderate	Moderate.
13F*:							
Buckcreek	20-40	Hard	---	---	Moderate	Moderate	Low.
Gwin	10-20	Hard	---	---	Moderate	Moderate	Low.
14B Burbank	>60	---	---	---	Low	High	Low.
15B, 15C, 15E Burke	>30	Hard	20-40	Thick	High	High	Low.
16B, 16C, 16D, 16E Cantala	>60	Hard	---	---	High	Moderate	Low.
17A*:							
Catherine Variant	>60	---	---	---	High	Moderate	Low.
Catherine	>60	---	---	---	High	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Thickness		Uncoated steel	Concrete
	In		In				
18B, 18C, 18E, 19D, 20D- Condon	20-40	Hard	---	---	High-----------	Moderate--------	Low.
21D*:							
Condon------------------	20-40	Hard	---	---	High-----------	Moderate--------	Low.
Bakeoven----------------	4-12	Hard	---	---	Moderate--------	Moderate--------	Low.
22C, 22D---------------- Cowsly	>60	---	---	---	High-----------	Moderate--------	Low.
23*. Dune land							
24B, 24C---------------- Ellisforde	>60	---	---	---	High-----------	High-----------	Low.
25C*:							
Ellisforde--------------	>60	---	---	---	High-----------	High-----------	Low.
Ellisforde, eroded------	>60	---	---	---	High-----------	High-----------	Low.
26E. Entic Durochrepts							
27A--------------------- Esquatzel	>60	---	---	---	High-----------	High-----------	Low.
28A, 29A---------------- Freewater	>60	---	---	---	Low------------	Moderate--------	Low.
30A*:							
Freewater---------------	>60	---	---	---	Low------------	Moderate--------	Low.
Urban land.							
31B, 31D, 31E----------- Gurdane	20-40	Hard	---	---	High-----------	Moderate--------	Low.
32E*:							
Gurdane-----------------	20-40	Hard	---	---	High-----------	Moderate--------	Low.
Gwinly------------------	10-20	Hard	---	---	Moderate--------	Moderate--------	Low.
33D*:							
Gurdane-----------------	20-40	Hard	---	---	High-----------	Moderate--------	Low.
Rockly------------------	5-12	Hard	---	---	Moderate--------	Moderate--------	Low.
34F*:							
Gwin--------------------	10-20	Hard	---	---	Moderate--------	Moderate--------	Low.
Klicker-----------------	20-40	Hard	---	---	Moderate--------	Moderate--------	Low.
Rock outcrop.							
35F*:							
Gwin--------------------	10-20	Hard	---	---	Moderate--------	Moderate--------	Low.
Rock outcrop.							
36E--------------------- Gwinly	10-20	Hard	---	---	Moderate--------	Moderate--------	Low.
37C, 37E---------------- Hankins	40-60	Soft	---	---	High-----------	Moderate--------	Moderate.

See footnote at end of table.

TABLE 16.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Thickness		Uncoated steel	Concrete
	In		In				
38C, 38E: Helter	>60	---	---	---	High	Moderate	Moderate.
39A: Hermiston	>60	---	---	---	High	High	Low.
40C, 40E: Kahler	40-60	Hard	---	---	Moderate	Moderate	Low.
41F: Kahler	40-60	Soft	---	---	Moderate	Moderate	Moderate.
42A, 43A: Kimberly	>60	---	---	---	Low	High	Low.
44D, 45E: Klicker	20-40	Hard	---	---	Moderate	Moderate	Low.
46C*, 46E*:							
Klicker	20-40	Hard	---	---	Moderate	Moderate	Low.
Anatone	10-20	Hard	---	---	Moderate	Moderate	Low.
Bocker	4-10	Hard	---	---	Moderate	Moderate	Low.
47B: Koehler	>60	---	20-40	Thick	Moderate	High	Low.
48E: Lickskillet	12-20	Hard	---	---	Moderate	High	Low.
49F*:							
Lickskillet	12-20	Hard	---	---	Moderate	High	Low.
Nansene	>60	---	---	---	High	High	Low.
50F*:							
Lickskillet	12-20	Hard	---	---	Moderate	High	Low.
Rock outcrop.							
51A, 52D, 53D: McKay	>60	---	---	---	High	High	Low.
54B, 54C, 54D, 54E: Mikkalo	20-40	Hard	---	---	Moderate	High	Low.
55A: Mondovi	>60	---	---	---	High	Moderate	Low.
56B, 56C, 56E, 57D, 58D: Morrow	20-40	Hard	---	---	High	High	Low.
59D*:							
Morrow	20-40	Hard	---	---	High	High	Low.
Bakeoven	4-12	Hard	---	---	Moderate	Moderate	Low.
60F: Nansene	>60	---	---	---	High	High	Low.
61A, 61C, 62C: Oliphant	>60	---	---	---	Moderate	High	Low.
63A: Onyx	>60	---	---	---	High	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Thickness		Uncoated steel	Concrete
	In		In				
64B, 64C, 64D, 64E: Palouse	>60	---	---	---	High	Moderate	Low.
65A, 66A: Pedigo	>60	---	---	---	High	High	High.
67B, 67C, 68D, 68E, 69D, 69E: Pilot Rock	>60	---	20-40	Thick	High	High	Low.
70*. Pits							
71A: Potamus	>60	---	---	---	Moderate	Moderate	Low.
72A: Powder	>60	---	---	---	High	High	Low.
73D, 73E: Prosser	20-40	Hard	---	---	High	High	Low.
74B, 75B, 75E, 76B: Quincy	>60	---	---	---	Low	High	Low.
77C: Quincy	>60	---	---	---	Low	High	Low.
78B*:							
Quincy	>60	---	---	---	Low	High	Low.
Rock outcrop.							
79B, 79C, 79D, 79E, 80B, 80C, 80D, 81E, 82E: Ritzville	>60	---	---	---	High	High	Low.
83C*:							
Ritzville	>60	---	---	---	High	High	Low.
Rock outcrop.							
84*. Riverwash							
85F*:							
Rock outcrop.							
Xeric Torriorthents.							
86D: Rockly	5-12	Hard	---	---	Moderate	Moderate	Low.
87B, 87C: Sagehill	>60	---	---	---	High	High	Low.
88B, 88C, 88D, 89B, 89C, 89D, 89E: Shano	>60	---	---	---	High	High	Low.
90A*:							
Silvies	>60	---	---	---	High	Moderate	Low.
Winom	>60	---	---	---	Moderate	High	Low.

See footnote at end of table.

TABLE 16.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Thickness		Uncoated steel	Concrete
	In		In				
91A Stanfield	>60	---	20-40	Thick	Moderate	High	Low.
92A Stanfield	>60	---	20-40	Thin	Moderate	High	Low.
93B Starbuck	12-20	Hard	---	---	High	Moderate	Low.
94A*:							
Starbuck	12-20	Hard	---	---	High	Moderate	Low.
Rock outcrop.							
95B Taunton	>60	---	20-40	Thick	Moderate	High	Low.
96B, 96D Thatuna	>60	---	---	---	Moderate	Moderate	Moderate.
97C, 97E, 98C, 98E Tolo	>60	---	---	---	High	Moderate	Moderate.
99C*, 99E*:							
Tolo	>60	---	---	---	High	Moderate	Moderate.
Kilmerque	20-40	Soft	---	---	Moderate	Moderate	Low.
100C*, 100E*:							
Tolo	>60	---	---	---	High	Moderate	Moderate.
Klicker	20-40	Hard	---	---	Moderate	Moderate	Low.
101A Tolo Variant	>60	---	---	---	High	Moderate	Moderate.
102C, 103E, 104E Tutuilla	40-60	Soft	---	---	High	Moderate	Low.
105A Umapine	>60	---	---	---	High	High	Low.
106A Umapine	>60	---	---	---	High	High	Low.
107E*, 107F*:							
Umatilla	>60	---	---	---	Moderate	Moderate	Moderate.
Kahler	>60	---	---	---	Moderate	Moderate	Moderate.
108F*:							
Umatilla	>60	---	---	---	Moderate	Moderate	Moderate.
Kahler	>60	---	---	---	Moderate	Moderate	Moderate.
Gwin	10-20	Hard	---	---	Moderate	Moderate	Low.
109A, 110A Veazie	>60	---	---	---	Moderate	Moderate	Low.
111A. Vitrandepts							
112B, 112D, 112E Waha	20-40	Hard	---	---	Moderate	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Thickness		Uncoated steel	Concrete
	In		In				
113D*:							
Waha	20-40	Hard	---	---	Moderate	Moderate	Low.
Rockly	5-12	Hard	---	---	Moderate	Moderate	Low.
114B, 114C, 115D, 115E, 116D, 117D Walla Walla	>60	---	---	---	High	High	Low.
118B Walla Walla	>60	---	40-60	Thin	High	High	Low.
119A Wanser	>60	---	---	---	Moderate	High	Low.
120C*:							
Wanser	>60	---	---	---	Moderate	High	Low.
Quincy	>60	---	---	---	Low	High	Low.
121B, 121C, 121D Willis	>40	Hard	20-40	Thick	High	High	Low.
122B Winchester	>60	---	---	---	Low	High	Low.
123B*:							
Winchester	>60	---	---	---	Low	High	Low.
Quinton	20-40	Hard	---	---	Low	High	Low.
124B*:							
Winchester	>60	---	---	---	Low	High	Low.
Urban land.							
125F*:							
Wrentham	20-40	Hard	---	---	Moderate	Moderate	Low.
Rock outcrop.							
126A. Xerofluvents							
127F. Xerollic Durorthids							
128A Yakima	>60	---	---	---	Moderate	Moderate	Low.
129A*:							
Yakima	>60	---	---	---	Moderate	Moderate	Low.
Urban land.							

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
1B, 1C, 2B, 2C----------- Adkins	B	None------------	---	---	>6.0	---	---
3A, 3C----------------- Adkins	C	None------------	---	---	1.5-3.5	Apparent	Apr-Oct
4B*:							
Adkins----------------	B	None------------	---	---	>6.0	---	---
Urban land.							
5C*:							
Albee-----------------	C	None------------	---	---	>6.0	---	---
Bocker----------------	D	None------------	---	---	>6.0	---	---
Anatone---------------	D	None------------	---	---	>6.0	---	---
6B, 6C, 6D, 6E---------- Anderly	C	None------------	---	---	>6.0	---	---
7C*:							
Anderly---------------	C	None------------	---	---	>6.0	---	---
Urban land.							
8B, 8C----------------- Athena	B	None------------	---	---	>6.0	---	---
9C--------------------- Bocker	D	None------------	---	---	>6.0	---	---
10D*:							
Bocker----------------	D	None------------	---	---	>6.0	---	---
Bridgecreek-----------	C	None------------	---	---	>6.0	---	---
11F*:							
Bowlus----------------	B	None------------	---	---	>6.0	---	---
Buckcreek-------------	C	None------------	---	---	>6.0	---	---
12C, 12E--------------- Bridgecreek	C	None------------	---	---	>6.0	---	---
13F*:							
Buckcreek-------------	C	None------------	---	---	>6.0	---	---
Gwin------------------	D	None------------	---	---	>6.0	---	---
14B-------------------- Burbank	A	None------------	---	---	>6.0	---	---
15B, 15C, 15E---------- Burke	C	None------------	---	---	>6.0	---	---
16B, 16C, 16D, 16E------ Cantala	B	None------------	---	---	>6.0	---	---

See footnote at end of table.

TABLE 17.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
17A*:							
Catherine Variant------	D	Occasional------	Brief---------	Dec-May	0-4.0	Apparent	Jan-Dec
Catherine--------------	C	Occasional------	Brief---------	Dec-May	2.0-4.0	Apparent	Dec-Jun
18B, 18C, 18E, 19D, 20D- Condon	C	None------------	---	---	>6.0	---	---
21D*:							
Condon-----------------	C	None------------	---	---	>6.0	---	---
Bakeoven---------------	D	None------------	---	---	>6.0	---	---
22C, 22D--------------- Cowsly	C	None------------	---	---	1.5-3.0	Perched	Mar-May
23*. Dune land							
24B, 24C--------------- Ellisforde	B	None------------	---	---	>6.0	---	---
25C*:							
Ellisforde-------------	B	None------------	---	---	>6.0	---	---
Ellisforde, eroded-----	B	None------------	---	---	>6.0	---	---
26E. Entic Durochrepts							
27A-------------------- Esquatzel	B	Rare------------	---	---	>6.0	---	---
28A, 29A--------------- Freewater	B	Rare------------	---	---	>6.0	---	---
30A*:							
Freewater--------------	B	Rare------------	---	---	>6.0	---	---
Urban land.							
31B, 31D, 31E---------- Gurdane	C	None------------	---	---	>6.0	---	---
32E*:							
Gurdane----------------	C	None------------	---	---	>6.0	---	---
Gwinly-----------------	D	None------------	---	---	>6.0	---	---
33D*:							
Gurdane----------------	C	None------------	---	---	>6.0	---	---
Rockly-----------------	D	None------------	---	---	>6.0	---	---
34F*:							
Gwin-------------------	D	None------------	---	---	>6.0	---	---
Klicker----------------	C	None------------	---	---	>6.0	---	---
Rock outcrop.							
35F*:							
Gwin-------------------	D	None------------	---	---	>6.0	---	---
Rock outcrop.							

See footnote at end of table.

TABLE 17.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
36E: Gwinly	D	None	---	---	>6.0	---	---
37C, 37E: Hankins	C	None	---	---	>6.0	---	---
38C, 38E: Helter	B	None	---	---	>6.0	---	---
39A: Hermiston	B	Rare	---	---	>6.0	---	---
40C, 40E, 41F: Kahler	B	None	---	---	>6.0	---	---
42A, 43A: Kimberly	B	Rare	---	---	>6.0	---	---
44D, 45E: Klicker	C	None	---	---	>6.0	---	---
46C*, 46E*:							
Klicker	C	None	---	---	>6.0	---	---
Anatone	D	None	---	---	>6.0	---	---
Bocker	D	None	---	---	>6.0	---	---
47B: Koehler	C	None	---	---	>6.0	---	---
48E: Lickskillet	D	None	---	---	>6.0	---	---
49F*:							
Lickskillet	D	None	---	---	>6.0	---	---
Nansene	B	None	---	---	>6.0	---	---
50F*:							
Lickskillet	D	None	---	---	>6.0	---	---
Rock outcrop.							
51A, 52D, 53D: McKay	C	None	---	---	>6.0	---	---
54B, 54C, 54D, 54E: Mikkalo	C	None	---	---	>6.0	---	---
55A: Mondovi	B	Rare	---	---	>6.0	---	---
56B, 56C, 56E, 57D, 58D: Morrow	C	None	---	---	>6.0	---	---
59D*:							
Morrow	C	None	---	---	>6.0	---	---
Bakeoven	D	None	---	---	>6.0	---	---
60F: Nansene	B	None	---	---	>6.0	---	---
61A, 61C, 62C: Oliphant	B	None	---	---	>6.0	---	---

See footnote at end of table.

TABLE 17.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
63A-------------------- Onyx	B	Rare------------	---	---	>6.0	---	---
64B, 64C, 64D, 64E------ Palouse	B	None------------	---	---	>6.0	---	---
65A, 66A--------------- Pedigo	C	Rare------------	---	---	2.5-3.5	Apparent	Jan-May
67B, 67C, 68D, 68E, 69D, 69E-------------------- Pilot Rock	C	None------------	---	---	>6.0	---	---
70*. Pits							
71A-------------------- Potamus	B	None------------	---	---	>6.0	---	---
72A-------------------- Powder	B	Rare------------	---	---	>6.0	---	---
73D, 73E--------------- Prosser	C	None------------	---	---	>6.0	---	---
74B, 75B, 75E, 76B------ Quincy	A	None------------	---	---	>6.0	---	---
77C-------------------- Quincy	A	None------------	---	---	>6.0	---	---
78B*:							
Quincy-----------------	A	None------------	---	---	>6.0	---	---
Rock outcrop.							
79B, 79C, 79D, 79E, 80B, 80C, 80D, 81E, 82E----- Ritzville	B	None------------	---	---	>6.0	---	---
83C*:							
Ritzville--------------	B	None------------	---	---	>6.0	---	---
Rock outcrop.							
84*. Riverwash							
85F*:							
Rock outcrop.							
Xeric Torriorthents.							
86D-------------------- Rockly	D	None------------	---	---	>6.0	---	---
87B, 87C--------------- Sagehill	B	None------------	---	---	>6.0	---	---
88B, 88C, 88D, 89B, 89C, 89D, 89E--------------- Shano	B	None------------	---	---	>6.0	---	---
90A*:							
Silvies----------------	D	None------------	---	---	+1-2.0	Apparent	May-Jul

See footnote at end of table.

TABLE 17.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months
					Ft		
90A*:							
Winom	D	Rare	---	---	3.0-6.0	Apparent	Mar-Jun
91A Stanfield	C	None	---	---	1.5-6.0	Perched	Feb-Jul
92A Stanfield	C	None	---	---	>6.0	---	---
93B Starbuck	D	None	---	---	>6.0	---	---
94A*:							
Starbuck	D	None	---	---	>6.0	---	---
Rock outcrop.							
95B Taunton	C	None	---	---	>6.0	---	---
96B, 96D Thatuna	C	None	---	---	3.0-4.0	Perched	Feb-Apr
97C, 97E, 98C, 98E Tolo	B	None	---	---	>6.0	---	---
99C*, 99E*:							
Tolo	B	None	---	---	>6.0	---	---
Kilmerque	C	None	---	---	>6.0	---	---
100C*, 100E*:							
Tolo	B	None	---	---	>6.0	---	---
Klicker	C	None	---	---	>6.0	---	---
101A Tolo Variant	D	Frequent	Long	Mar-Jun	+1-3.0	Apparent	Mar-Oct
102C, 103E, 104E Tutuilla	C	None	---	---	>6.0	---	---
105A Umapine	C	Occasional	Brief	Jan-Apr	1.0-4.0	Apparent	Nov-Jun
106A Umapine	C	Rare	---	---	4.0-6.0	Apparent	Nov-Jun
107E*, 107F*:							
Umatilla	B	None	---	---	>6.0	---	---
Kahler	B	None	---	---	>6.0	---	---
108F*:							
Umatilla	B	None	---	---	>6.0	---	---
Kahler	B	None	---	---	>6.0	---	---
Gwin	D	None	---	---	>6.0	---	---
109A, 110A Veazie	B	Rare	---	---	4.0-6.0	Apparent	Feb-Apr
111A. Vitrandepts							

See footnote at end of table.

TABLE 17.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
112B, 112D, 112E-------- Waha	C	None-----------	---	---	>6.0	---	---
113D*:							
Waha-----------------	C	None-----------	---	---	>6.0	---	---
Rockly---------------	D	None-----------	---	---	>6.0	---	---
114B, 114C, 115D, 115E, 116D, 117D, 118B------- Walla Walla	B	None-----------	---	---	>6.0	---	---
119A------------------ Wanser	D	Rare-----------	---	---	0.5-1.0	Apparent	May-Nov
120C*:							
Wanser---------------	D	Rare-----------	---	---	0.5-1.0	Apparent	May-Nov
Quincy---------------	A	None-----------	---	---	>6.0	---	---
121B, 121C, 121D-------- Willis	C	None-----------	---	---	>6.0	---	---
122B------------------ Winchester	A	None-----------	---	---	>6.0	---	---
123B*:							
Winchester-----------	A	None-----------	---	---	>6.0	---	---
Quinton--------------	C	None-----------	---	---	>6.0	---	---
124B*:							
Winchester-----------	A	None-----------	---	---	>6.0	---	---
Urban land.							
125F*:							
Wrentham-------------	C	None-----------	---	---	>6.0	---	---
Rock outcrop.							
126A. Xerofluvents							
127F. Xerollic Durorthids							
128A------------------ Yakima	B	Rare-----------	---	---	4.0-6.0	Apparent	Jan-Mar
129A*:							
Yakima---------------	B	Rare-----------	---	---	4.0-6.0	Apparent	Jan-Mar
Urban land.							

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Adkins	Coarse-loamy, mixed, mesic Xerollic Camborthids
Albee	Fine-loamy, mixed, frigid Ultic Haploxerolls
Anatone	Loamy-skeletal, mixed, frigid Lithic Haploxerolls
Anderly	Coarse-silty, mixed, mesic Typic Haploxerolls
Athena	Fine-silty, mixed, mesic Pachic Haploxerolls
Bakeoven	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
Bocker	Loamy-skeletal, mixed, frigid Lithic Haploxerolls
Bowlus	Fine-silty, mixed, frigid Pachic Ultic Haploxerolls
Bridgecreek	Fine, montmorillonitic, frigid Typic Palexerolls
Buckcreek	Loamy-skeletal, mixed, frigid Pachic Ultic Haploxerolls
Burbank	Sandy-skeletal, mixed, mesic Xeric Torriorthents
Burke	Coarse-silty, mixed, mesic Xerollic Durorthids
Cantala	Fine-silty, mixed, mesic Typic Haploxerolls
Catherine	Fine-silty, mixed, mesic Cumulic Haplaquolls
Catherine Variant	Fine-loamy, mixed mesic Cumulic Haplaquolls
Condon	Fine-silty, mixed, mesic Typic Haploxerolls
Cowsly	Fine, montmorillonitic, frigid Xeric Argialbolls
Ellisforde	Coarse-silty, mixed, mesic Calciorthidic Haploxerolls
Entic Durochrepts	Entic Durochrepts
Esquatzel	Coarse-silty, mixed, mesic Torrifluventic Haploxerolls
Freewater	Sandy-skeletal, mixed, mesic Fluventic Haploxerolls
Gurdane	Clayey-skeletal, montmorillonitic, mesic Pachic Argixerolls
Gwin	Loamy-skeletal, mixed, mesic Lithic Argixerolls
Gwinly	Clayey-skeletal, montmorillonitic, mesic Lithic Argixerolls
Hankins	Fine, montmorillonitic, frigid Ultic Palexerolls
Helter	Medial over loamy, mixed Entic Cryandepts
Hermiston	Coarse-silty, mixed, mesic Cumulic Haploxerolls
Kahler	Fine-loamy, mixed, frigid Pachic Ultic Haploxerolls
Kilmerque	Coarse-loamy, mixed, frigid Ultic Haploxerolls
Kimberly	Coarse-loamy, mixed, mesic Torrifluventic Haploxerolls
Klicker	Loamy-skeletal, mixed, frigid Ultic Argixerolls
Koehler	Sandy, mixed, mesic Xerollic Durorthids
Lickskillet	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
McKay	Fine-silty, mixed, mesic Calcic Argixerolls
Mikkalo	Coarse-silty, mixed, mesic Calciorthidic Haploxerolls
Mondovi	Coarse-silty, mixed, mesic Cumulic Haploxerolls
Morrow	Fine-silty, mixed, mesic Calcic Argixerolls
Nansene	Coarse-silty, mixed, mesic Pachic Haploxerolls
Oliphant	Coarse-silty, mixed, mesic Calcic Haploxerolls
Onyx	Coarse-silty, mixed, mesic Cumulic Haploxerolls
Palouse	Fine-silty, mixed, mesic Pachic Ultic Haploxerolls
Pedigo	Coarse-silty, mixed, mesic Cumulic Haploxerolls
Pilot Rock	Coarse-silty, mixed, mesic Haplic Durixerolls
Potamus	Loamy-skeletal, mixed, frigid Typic Haploxerolls
Powder	Coarse-silty, mixed, mesic Cumulic Haploxerolls
Prosser	Coarse-loamy, mixed, mesic Xerollic Camborthids
Quincy	Mixed, mesic Xeric Torripsamments
Quinton	Mixed, mesic Xeric Torripsamments
Ritzville	Coarse-silty, mixed, mesic Calciorthidic Haploxerolls
Rockly	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
Sagehill	Coarse-loamy, mixed, mesic Xerollic Camborthids
Shano	Coarse-silty, mixed, mesic Xerollic Camborthids
Silvies	Fine, montmorillonitic Cumulic Cryaquolls
Stanfield	Coarse-silty, mixed, mesic Xerollic Durorthids
Starbuck	Loamy, mixed, mesic Lithic Xerollic Camborthids
Taunton	Coarse-loamy, mixed, mesic Xerollic Durorthids
Thatuna	Fine-silty, mixed, mesic Xeric Argialbolls
Tolo	Medial over loamy, mixed, frigid Typic Vitrandepts
Tolo Variant	Medial, nonacid Andic Cryaquepts
Tutuilla	Fine, montmorillonitic, mesic Typic Palexerolls
Umapine	Coarse-silty, mixed (calcareous), mesic Typic Halaquepts
Umatilla	Loamy-skeletal, mixed, frigid Pachic Ultic Haploxerolls
Veazie	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Cumulic Haploxerolls
Vitrandepts	Vitrandepts
Waha	Fine-loamy, mixed, mesic Pachic Argixerolls
Walla Walla	Coarse-silty, mixed, mesic Typic Haploxerolls
Wanser	Mixed, mesic Typic Psammaquents
Willis	Coarse-silty, mixed, mesic Orthidic Durixerolls

TABLE 18.--CLASSIFICATION OF THE SOILS--Continued

Soil name	Family or higher taxonomic class
Winchester	Mixed, mesic Xeric Torripsamments
Winom	Fine, montmorillonitic, frigid Chromic Pelloxererts
Wrentham	Loamy-skeletal, mixed, mesic Pachic Haploxerolls
Xeric Torriorthents	Xeric Torriorthents
Xerofluvents	Xerofluvents
Xerollic Durorthids	Xerollic Durorthids
Yakima	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Cumulic Haploxerolls

* U.S. GOVERNMENT PRINTING OFFICE : 1988 O - 183-557

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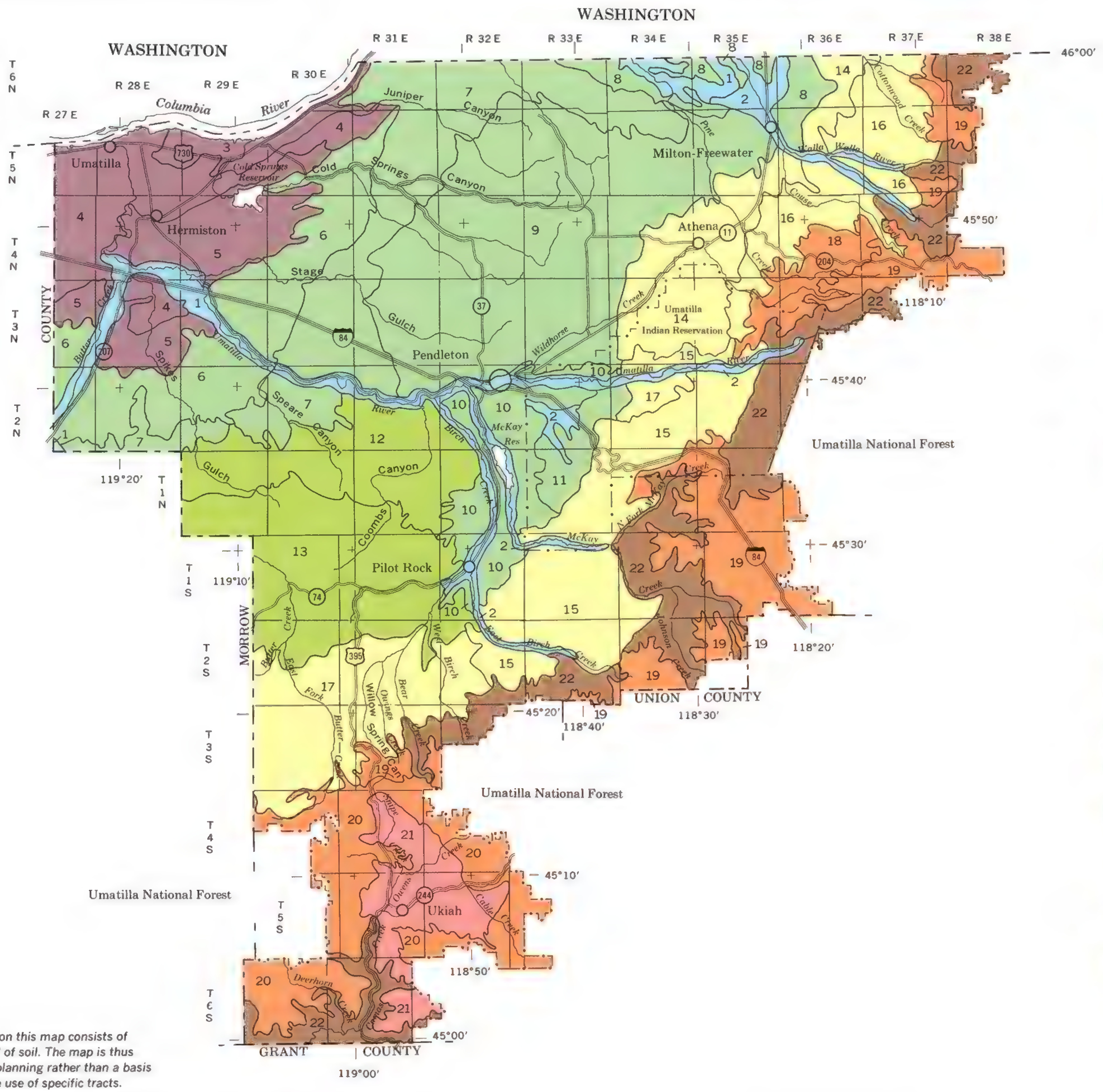

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND

SOILS THAT FORMED IN ALLUVIUM ON FLOOD PLAINS AND TERRACES

1 Powder-Umapine-Pedigo: Deep, well drained, moderately well drained, and somewhat poorly drained soils that formed in silty alluvium; on flood plains and terraces

2 Freewater-Hermiston-Xerofluvents: Deep, excessively drained to somewhat poorly drained soils that formed in mixed and silty alluvium; on flood plains

SOILS THAT FORMED IN EOLIAN SAND, LOESS ALLUVIUM AND LACUSTRINE SEDIMENT ON TERRACES OF THE COLUMBIA RIVER

3 Quincy-Starbuck-Rock outcrop: Deep and shallow, excessively drained and well drained soils that formed in eolian sand and loess, and Rock outcrop; on strath terraces

4 Quincy-Winchester-Burbank: Deep, excessively drained soils that formed in eolian sand and gravelly alluvium; on terraces

5 Adkins-Sagehill-Quincy: Deep, well drained and excessively drained soils that formed in eolian sand, gravelly alluvium, and lacustrine sediment; on terraces

SOILS THAT FORMED IN LOESS, LACUSTRINE SEDIMENT, AND ALLUVIUM ON HILLS, TERRACES, AND PIEDMONTS

6 Shano-Burke: Deep and moderately deep, well drained soils that formed in loess overlying lacustrine sediment and cemented alluvium; on terraces

7 Ritzville: Deep, well drained soils that formed in loess; on hills

8 Oliphant-Ellisforde: Deep, well drained soils that formed in loess overlying lacustrine sediment; on terraces

9 Walla Walla: Deep, well drained soils that formed in loess; on hills

10 Pilot Rock: Moderately deep, well drained soils that formed in loess overlying cemented alluvium; on fan terraces

11 McKay: Deep, well drained soils that formed in loess overlying alluvium; on fan piedmonts

SOILS THAT FORMED IN LOESS, COLLUVIUM, AND ALLUVIUM ON HILLS

12 Condon-Lickskillet: Moderately deep and shallow, well drained soils that formed in loess and colluvium; on ridges and hillslopes

13 Morrow-Lickskillet: Moderately deep and shallow, well drained soils that formed in loess, colluvium, and loamy alluvium; on ridges and hillslopes

SOILS THAT FORMED IN LOESS, RESIDUUM, AND COLLUVIUM ON THE FOOTHILLS OF THE BLUE MOUNTAINS

14 Athena: Deep, well drained soils that formed in loess; on hills

15 Gwin-Gurdane-Rockly: Shallow, moderately deep and very shallow, well drained soils that formed in loess, residuum, and colluvium; on hillslopes and ridges

16 Waha-Palouse-Gwin: Moderately deep, deep, and shallow, well drained soils that formed in loess, residuum and colluvium; on ridges and hillslopes

17 Gurdane-Gwinly: Moderately deep and shallow, well drained soils that formed in loess, residuum, and colluvium; on ridges and hillslopes

SOILS THAT FORMED IN LOESS, VOLCANIC ASH, AND RESIDUUM ON PLATEAUS AND HILLS OF THE BLUE MOUNTAINS

18 Cowsly-Thatuna: Deep, moderately well drained soils that formed in loess and residuum; on plateaus

19 Tolo-Klicker: Deep and moderately deep, well drained soils that formed in volcanic ash, loess, and residuum; on plateaus and hillslopes

20 Anatone-Klicker-Tolo: Shallow, moderately deep and deep, well drained soils that formed in loess, residuum and volcanic ash; on plateaus and hillslopes

SOILS THAT FORMED IN LOESS AND TUFFACEOUS SEDIMENT ON TERRACES OF THE BLUE MOUNTAINS

21 Bridgecreek-Hankins: Moderately deep and deep, well drained soils that formed in loess overlying tuffaceous sediment; on terraces

SOILS THAT FORMED IN LOESS, COLLUVIUM, AND RESIDUUM ON HILLS OF THE BLUE MOUNTAINS

22 Gwin-Umatilla-Kahler: Shallow and deep, well drained soils that formed in colluvium, residuum, and loess; on hillslopes

COMPILED 1984

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SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

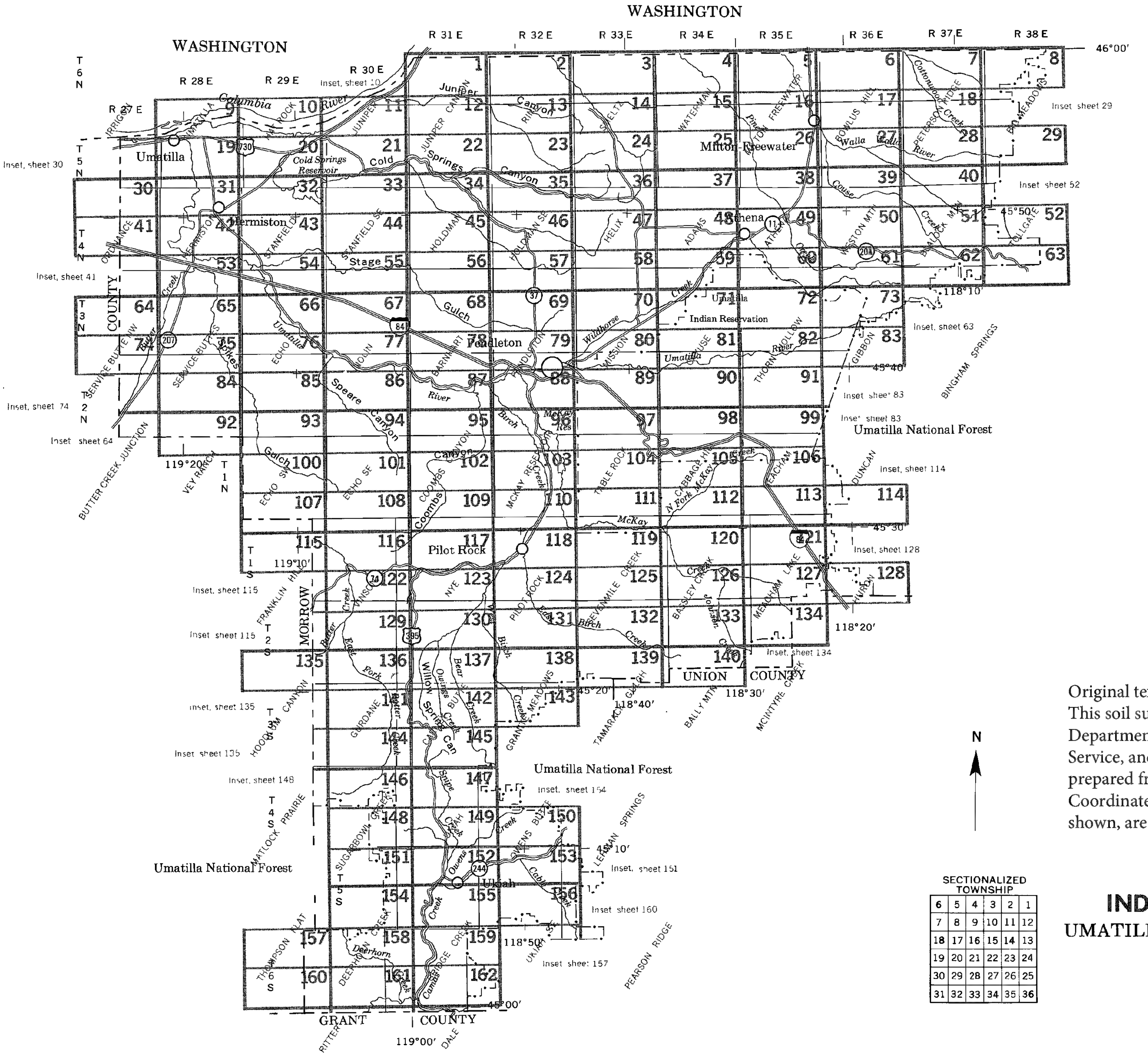
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
BUREAU OF INDIAN AFFAIRS
OREGON AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
UMATILLA COUNTY AREA, OREGON

Scale 1:506,880

1 0 1 2 3 4 5 6 7 8 Miles

0 8 16 Km



Original text from each individual map sheet read: This soil survey map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1980 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

UMATILLA COUNTY AREA, OREGON

Scale 1:506,880

1 0 1 2 3 4 5 6 7 8 Miles

0 8 16 Km

SOIL LEGEND

SYMBOL	NAME
1B	Adkins fine sandy loam, 0 to 5 percent slopes
1C	Adkins fine sandy loam, 5 to 25 percent slopes
2B	Adkins fine sandy loam, gravelly substratum, 0 to 5 percent slopes
2C	Adkins fine sandy loam, gravelly substratum, 5 to 25 percent slopes
3A	Adkins fine sandy loam, wet, 0 to 3 percent slopes
3C	Adkins fine sandy loam, wet, 3 to 15 percent slopes
4B	Adkins-Urban land complex, 0 to 5 percent slopes
5C	Albee Bocker Anatone complex, 2 to 15 percent slopes
6B	Anderly silt loam, 1 to 7 percent slopes
6C	Anderly silt loam, 7 to 12 percent slopes
6D	Anderly silt loam, 12 to 20 percent slopes
6E	Anderly silt loam, 20 to 35 percent slopes
7C	Anderly-Urban land complex 7 to 12 percent slopes
8B	Athena silt loam, 1 to 7 percent slopes
8C	Athena silt loam, 7 to 12 percent slopes
9C	Bocker very cobbly silt loam, 2 to 12 percent slopes
10D	Bocker-Bridgecreek complex, 1 to 15 percent slopes
11F	Bowlus-Buckcreek association, 40 to 70 percent slopes
12C	Bridgecreek silt loam 1 to 12 percent slopes
12E	Bridgecreek silt loam 12 to 35 percent slopes
13F	Buckcreek Gwin association, 45 to 70 percent slopes
14B	Burbank loamy fine sand, 0 to 5 percent slopes
15B	Burke silt loam, 1 to 7 percent slopes
15C	Burke silt loam 7 to 12 percent slopes
15E	Burke silt loam 12 to 30 percent slopes
16B	Cantala silt loam, 1 to 7 percent slopes
16C	Cantala silt loam, 7 to 12 percent slopes
16D	Cantala silt loam, 12 to 20 percent slopes
16E	Cantala silt loam, 20 to 35 percent slopes
17A	Catherine Variant-Catherine silt loams, 0 to 3 percent slopes
18B	Condon silt loam, 1 to 7 percent slopes
18C	Condon silt loam, 7 to 12 percent slopes
18E	Condon silt loam, 20 to 35 percent slopes
19D	Condon silt loam, 12 to 20 percent north slopes
20D	Condon silt loam, 12 to 20 percent south slopes
21D	Condon-Bakeoven complex, 2 to 20 percent slopes
22C	Cowsly silt loam, 2 to 12 percent slopes
22D	Cowsly silt loam, 12 to 20 percent slopes
23	Dune land
24B	Ellisforde silt loam, 1 to 7 percent slopes
24C	Ellisforde silt loam, 7 to 20 percent slopes
25C	Ellisforde-Ellisforde, eroded complex, 1 to 20 percent slopes
26E	Entic Durochrepts, 20 to 40 percent slopes
27A	Esquatzel silt loam, 0 to 3 percent slopes
28A	Freewater gravelly silt loam, 0 to 3 percent slopes
29A	Freewater very cobbly loam 0 to 3 percent slopes
30A	Freewater Urban land complex, 0 to 3 percent slopes
31B	Gurdane silty clay loam, 0 to 7 percent slopes
31D	Gurdane silty clay loam, 7 to 25 percent slopes
31E	Gurdane silty clay loam, 25 to 45 percent slopes
32E	Gurdane-Gwinly association, 20 to 40 percent slopes
33D	Gurdane-Rockly complex, 2 to 20 percent slopes
34F	Gwin-Klicker-Rock outcrop complex, 30 to 70 percent slopes
35F	Gwin-Rock outcrop complex, 40 to 70
36E	Gwinly very cobbly silt loam, 7 to 40 percent slopes
37C	Hankins silt loam, 2 to 15 percent slopes
37E	Hankins silt loam, 15 to 35 percent slopes
38C	Helter silt loam, 2 to 15 percent slopes
38E	Helter silt loam, 15 to 35 percent slopes
39A	Hermiston silt loam, 0 to 3 percent slopes
40C	Kahler silt loam, 2 to 15 percent slopes
40E	Kahler silt loam, 15 to 35 percent slopes
41F	Kahler gravelly loam, granite substratum, 35 to 70 percent slopes
42A	Kimberly fine sandy loam, 0 to 3 percent slopes
43A	Kimberly silt loam, 0 to 3 percent slopes
44D	Klicker silt loam, 2 to 20 percent slopes
45E	Klicker very stony silt loam, 20 to 40 percent slopes
46C	Klicker-Anatone-Bocker complex, 2 to 15 percent slopes
46E	Klicker-Anatone-Bocker complex, 15 to 35 percent slopes
47B	Koehler loamy fine sand, 0 to 5 percent slopes
48E	Lickskillet very stony loam, 7 to 40 percent slopes
49F	Lickskillet-Nansene association, 35 to 70 percent slopes
50F	Lickskillet-Rock outcrop complex, 40 to 70 percent slopes
51A	McKay silt loam, 0 to 7 percent slopes
52D	McKay silt loam, 7 to 25 percent north slopes
53D	McKay silt loam, 7 to 25 percent south slopes
54B	Mikkalo silt loam, 2 to 7 percent slopes
54C	Mikkalo silt loam, 7 to 12 percent slopes
54D	Mikkalo silt loam, 12 to 20 percent slopes
54E	Mikkalo silt loam, 20 to 35 percent slopes
55A	Mondovi silt loam, 0 to 3 percent slopes
56B	Morrow silt loam, 1 to 7 percent slopes
56C	Morrow silt loam, 7 to 12 percent slopes
56E	Morrow silt loam, 20 to 35 percent slopes
57D	Morrow silt loam, 12 to 20 percent north slopes
58D	Morrow silt loam, 12 to 20 percent south slopes
59D	Morrow-Bakeoven complex 2 to 20 percent slopes
60F	Nansene silt loam 35 to 70 percent slopes
61A	Oliphant silt loam, 0 to 3 percent slopes
61C	Oliphant silt loam, 3 to 12 percent slopes
62C	Oliphant silt loam, 3 to 25 percent slopes, eroded
63A	Onyx silt loam, 0 to 3 percent slopes
64B	Palouse silt loam, 1 to 7 percent slopes
64C	Palouse silt loam, 7 to 12 percent slopes
64D	Palouse silt loam, 12 to 20 percent slopes
64E	Palouse silt loam, 20 to 35 percent slopes
65A	Pedigo loamy fine sand, 0 to 3 percent slopes
66A	Pedigo silt loam, 0 to 3 percent slopes
67B	Pilot Rock silt loam, 1 to 7 percent slopes
67C	Pilot Rock silt loam, 7 to 12 percent slopes
68D	Pilot Rock silt loam, 12 to 20 percent north slopes
68E	Pilot Rock silt loam, 20 to 35 percent north slopes
69D	Pilot Rock silt loam, 12 to 20 percent south slopes
69E	Pilot Rock silt loam, 20 to 30 percent south slopes
70	Pits, gravel
71A	Potamus gravelly loam 0 to 2 percent slopes
72A	Powder silt loam, 0 to 3 percent slopes
73D	Prosser silt loam, 12 to 20 percent slopes
73E	Prosser silt loam, 20 to 40 percent slopes
74B	Quincy fine sand, 0 to 5 percent slopes
75B	Quincy loamy fine sand, 0 to 5 percent slopes
75E	Quincy loamy fine sand, 5 to 25 percent slopes
76B	Quincy loamy fine sand, gravelly substratum, 0 to 5 percent slopes
77C	Quincy loamy fine sand, 0 to 25 percent slopes, eroded
78B	Quincy-Rock outcrop complex, 1 to 20 percent slopes
79B	Ritzville very fine sandy loam, 2 to 7 percent slopes
79C	Ritzville very fine sandy loam, 7 to 12 percent slopes
79D	Ritzville very fine sandy loam, 12 to 25 percent slopes
79E	Ritzville very fine sandy loam, 25 to 50 percent slopes
80B	Ritzville silt loam, 2 to 7 percent slopes
80C	Ritzville silt loam, 7 to 12 percent slopes
80D	Ritzville silt loam, 12 to 25 percent slopes
81E	Ritzville silt loam, 25 to 40 percent north slopes
82E	Ritzville silt loam, 25 to 40 percent south slopes
83C	Ritzville-Rock outcrop complex, 0 to 25 percent slopes
84	Riverwash
85F	Rock outcrop-Xeric Torriorthents complex, 10 to 70 percent slopes
86D	Rockly very cobbly loam, 2 to 20 percent slopes
87B	Sagehill fine sandy loam, 2 to 5 percent slopes
87C	Sagehill fine sandy loam, 5 to 12 percent slopes
88B	Shano very fine sandy loam, 2 to 7 percent slopes
88C	Shano very fine sandy loam, 7 to 12 percent slopes
88D	Shano very fine sandy loam, 12 to 25 percent slopes
89B	Shano silt loam, 2 to 7 percent slopes
89C	Shano silt loam, 7 to 12 percent slopes
89D	Shano silt loam, 12 to 25 percent slopes
89E	Shano silt loam, 25 to 40 percent slopes
90A	Silvies-Winom complex, 0 to 3 percent slopes
91A	Stanfield silt loam, 0 to 3 percent slopes
92A	Stanfield silt loam, reclaimed, 0 to 3 percent slopes
93B	Starbuck very fine sandy loam, 2 to 20 percent slopes
94A	Starbuck-Rock outcrop complex, 0 to 5 percent slopes
95B	Taunton fine sandy loam, 1 to 7 percent slopes
96B	Thatuna silt loam, 1 to 7 percent slopes
96D	Thatuna silt loam, 7 to 20 percent slopes
97C	Tolo silt loam, 3 to 15 percent slopes
97E	Tolo silt loam, 15 to 35 percent slopes
98C	Tolo silt loam, granite substratum, 3 to 15 percent slopes
98E	Tolo silt loam, granite substratum, 15 to 35 percent slopes
99C	Tolo-Kilmerque association, 3 to 15 percent slopes
99E	Tolo-Kilmerque association, 15 to 35 percent slopes
100C	Tolo-Klicker association, 3 to 15 percent slopes
100E	Tolo-Klicker association, 15 to 35 percent slopes
101A	Tolo Variant silt loam, 0 to 3 percent slopes
102C	Tutuilla silty clay loam, 1 to 15 percent slopes
103E	Tutuilla silty clay loam, 15 to 35 percent north slopes
104E	Tutuilla silty clay loam, 15 to 35 percent south slopes
105A	Umapine silt loam, 0 to 3 percent slopes
106A	Umapine silt loam, reclaimed, 0 to 3 percent slopes
107E	Umatilla-Kahler association, 15 to 35 percent slopes
107F	Umatilla Kahler association, 35 to 70 percent slopes
108F	Umatilla-Kahler-Gwin association, 35 to 70 percent slopes
109A	Veazie silt loam, 0 to 3 percent slopes
110A	Veazie cobbly loam 0 to 3 percent slopes
111A	Vitrandepts, 0 to 5 percent slopes
112B	Waha silty clay loam, 1 to 12 percent slopes
112D	Waha silty clay loam, 12 to 25 percent slopes
112E	Waha silty clay loam, 25 to 40 percent slopes
113D	Waha-Rockly complex, 2 to 20 percent slopes
114B	Walla Walla silt loam, 1 to 7 percent slopes
114C	Walla Walla silt loam, 7 to 12 percent slopes
115D	Walla Walla silt loam, 12 to 25 percent north slopes
115E	Walla Walla silt loam, 25 to 40 percent north slopes
116D	Walla Walla silt loam, 12 to 25 percent south slopes
117D	Walla Walla silt loam, 12 to 25 percent south slopes eroded
118B	Walla Walla silt loam, hardpan substratum, 1 to 7 percent slopes
119A	Wanser loamy fine sand, 0 to 3 percent slopes
120C	Wanser-Quincy complex, 0 to 12 percent slopes
121B	Willis silt loam, 2 to 7 percent slopes
121C	Willis silt loam, 7 to 12 percent slopes
121D	Willis silt loam, 12 to 30 percent slopes
122B	Winchester sand, 0 to 5 percent slopes
123B	Winchester-Quinton complex, 0 to 5 percent slopes
124B	Winchester-Urban land complex, 0 to 5 percent slopes
125F	Wrentham-Rock outcrop complex, 35 to 70 percent slopes
126A	Xerofluvents, 0 to 3 percent slopes
127F	Xerollic Durorthids, 30 to 60 percent slopes
128A	Yakima silt loam, 0 to 3 percent slopes
129A	Yakima-Urban land complex, 0 to 3 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label) — Hedley Airstrip

- Small airport, airfield, park, oilfield, cemetery, or flood pool — FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 12C 112E

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

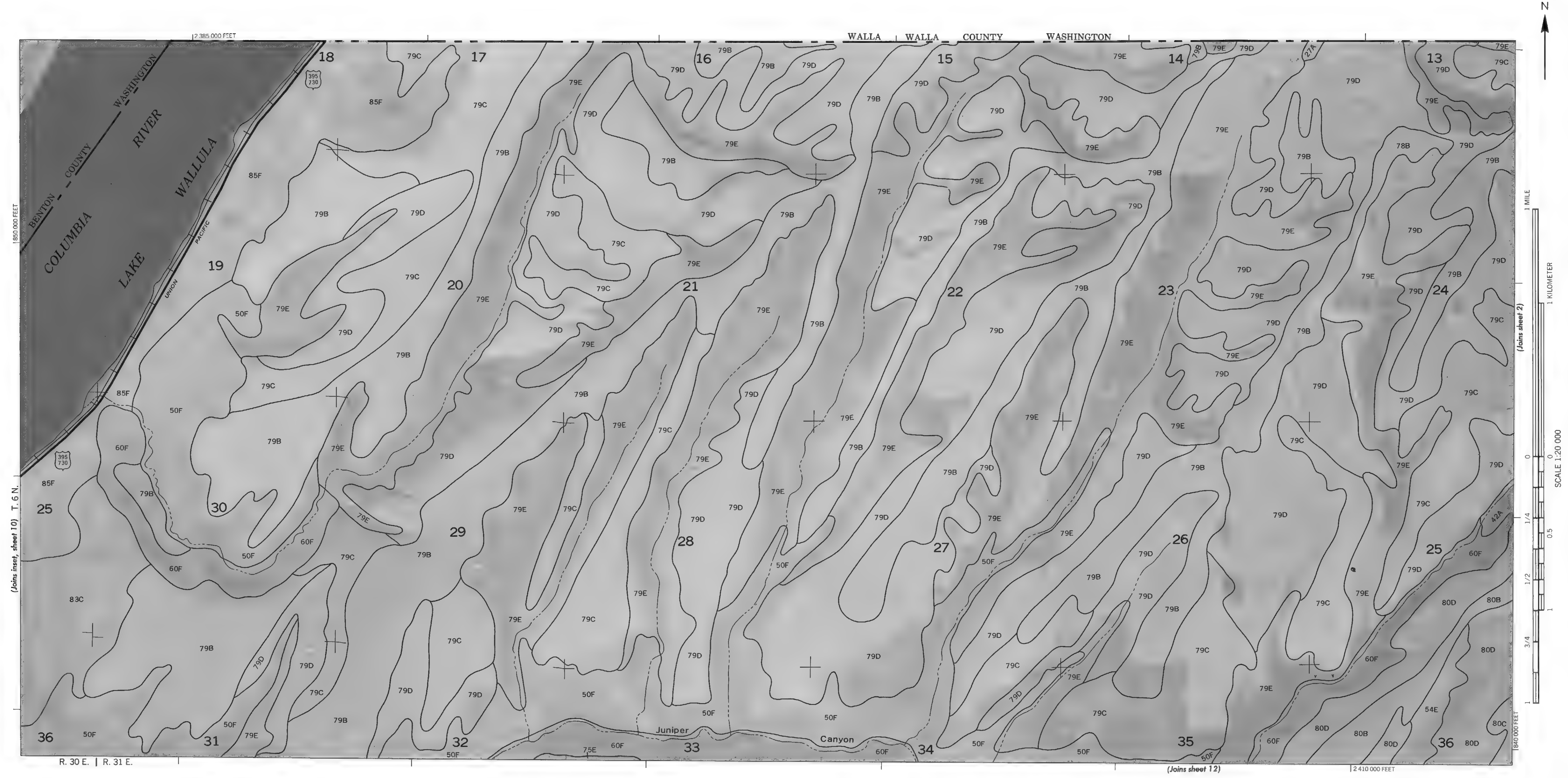
GULLY

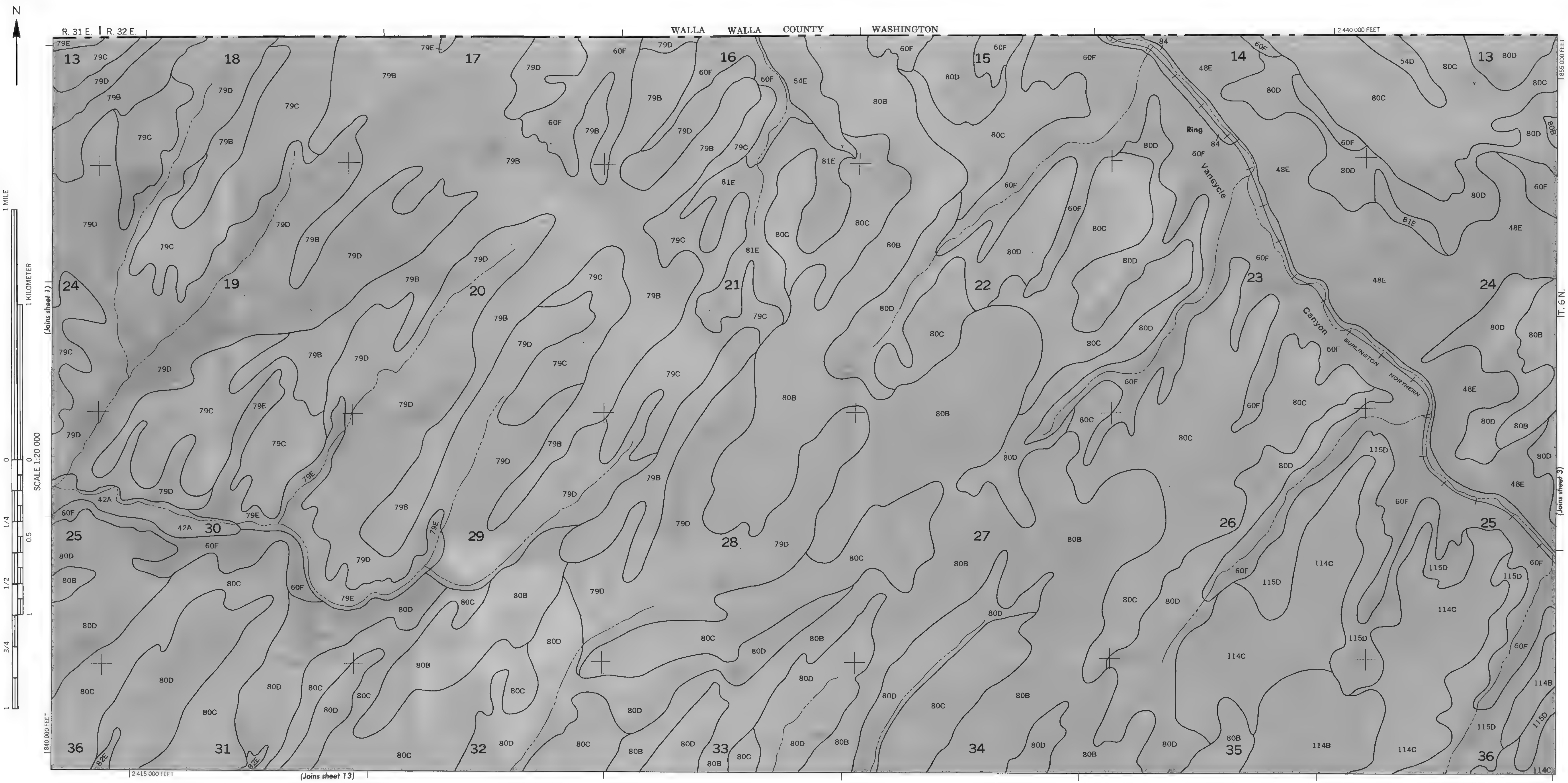
DEPRESSION OR SINK

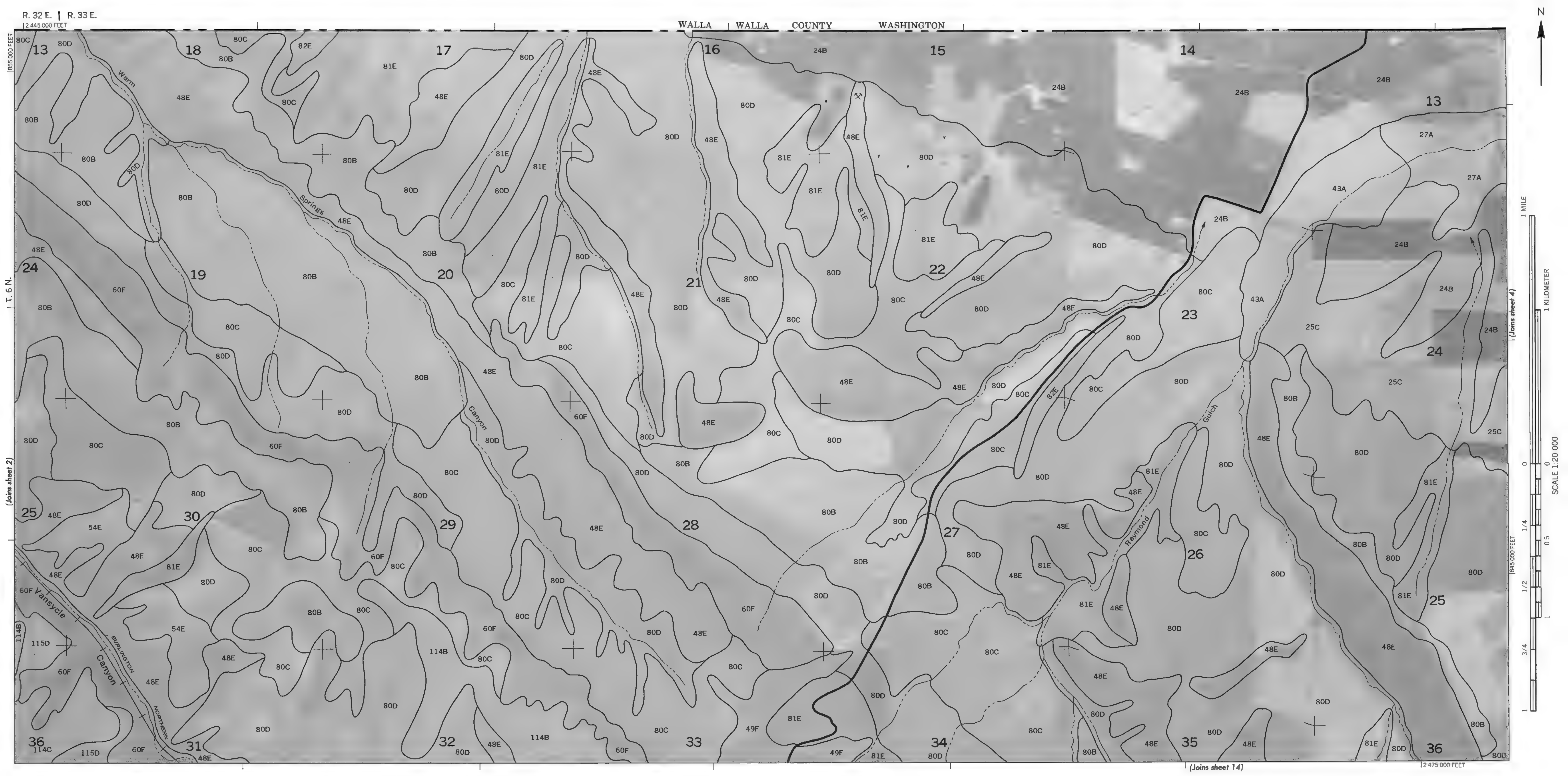
SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Ash spot


1
N
WALLA WALLA COUNTY WASHINGTON
BENTON COUNTY WASHINGTON
COLUMBIA RIVER
LAKE WALLULA
UNION PACIFIC
Juniper Canyon
2 385 000 FEET
1 850 000 FEET
840 000 FEET
2 410 000 FEET
T. 6 N.
R. 30 E. | R. 31 E.
(Joins inset, sheet 10)
(Joins sheet 2)
(Joins sheet 12)
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5


2
N
1 MILE
1 KILOMETER
SCALE 1:20 000
R. 31 E.
R. 32 E.
WALLA WALLA COUNTY
WASHINGTON
2 440 000 FEET
855 000 FEET
T. 6 N.
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 13)
2 415 000 FEET
840 000 FEET
Ring
Vansycle
Canyon
BURLINGTON NORTHERN
84


3
N
R. 32 E. | R. 33 E.
2 445 000 FEET
855 000 FEET
WALLA | WALLA COUNTY WASHINGTON
T. 6 N.
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 14)
845 000 FEET
2 475 000 FEET
Warm Springs Canyon
Vansycle Canyon
BURLINGTON NORTHERN
Raymond Gulch
1 MILE
1 KILOMETER
SCALE 1:20 000
13
18
17
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23
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28
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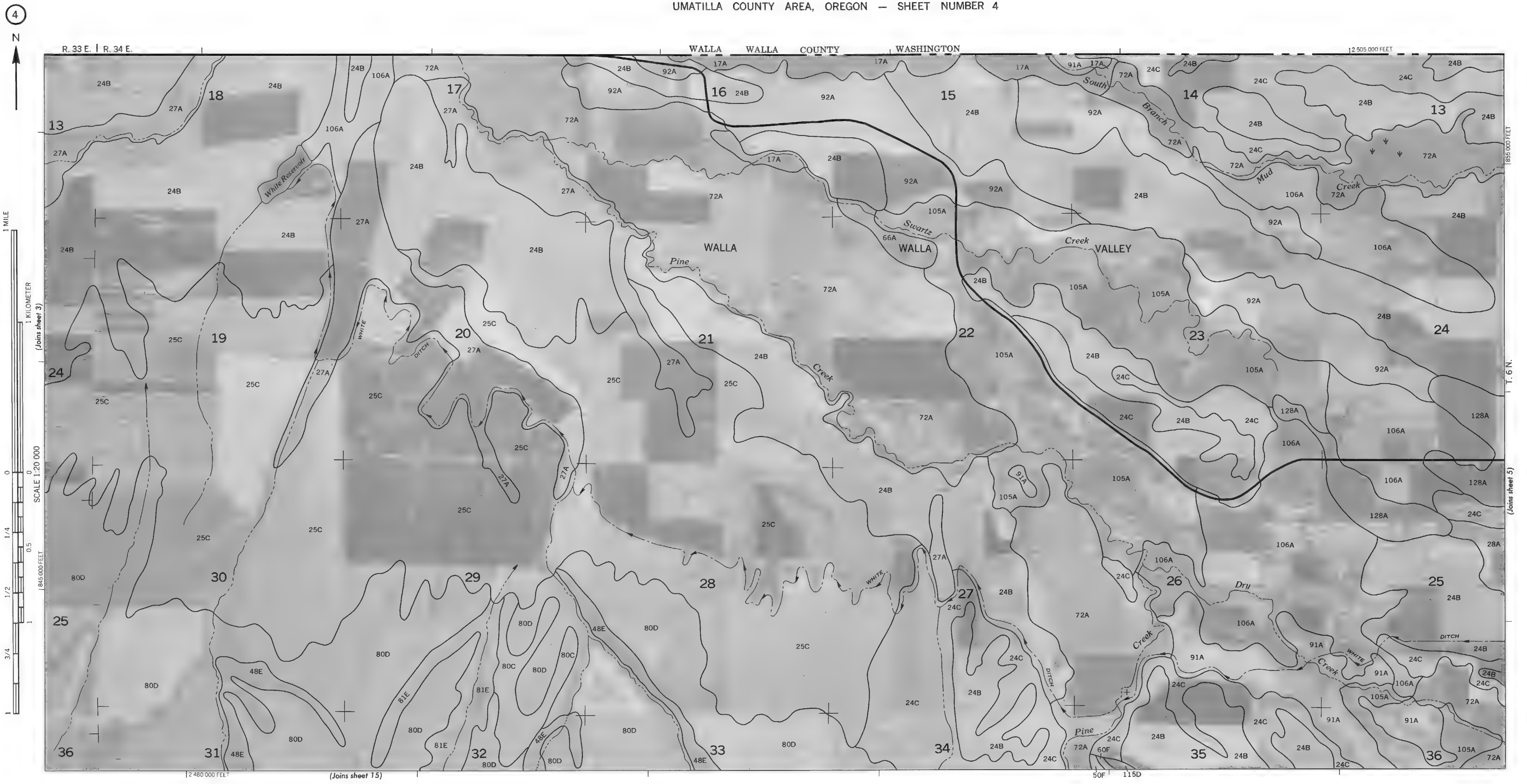
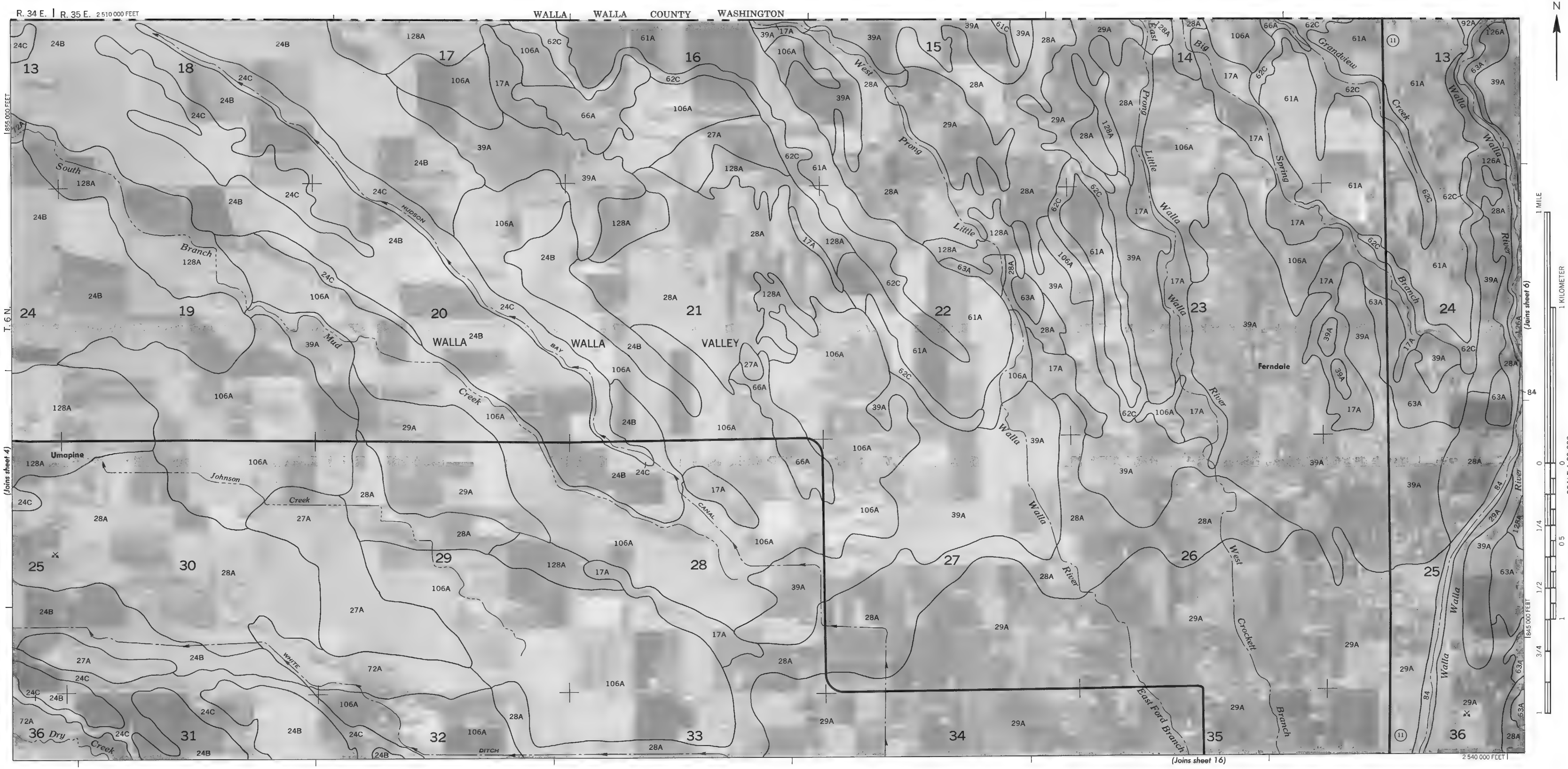
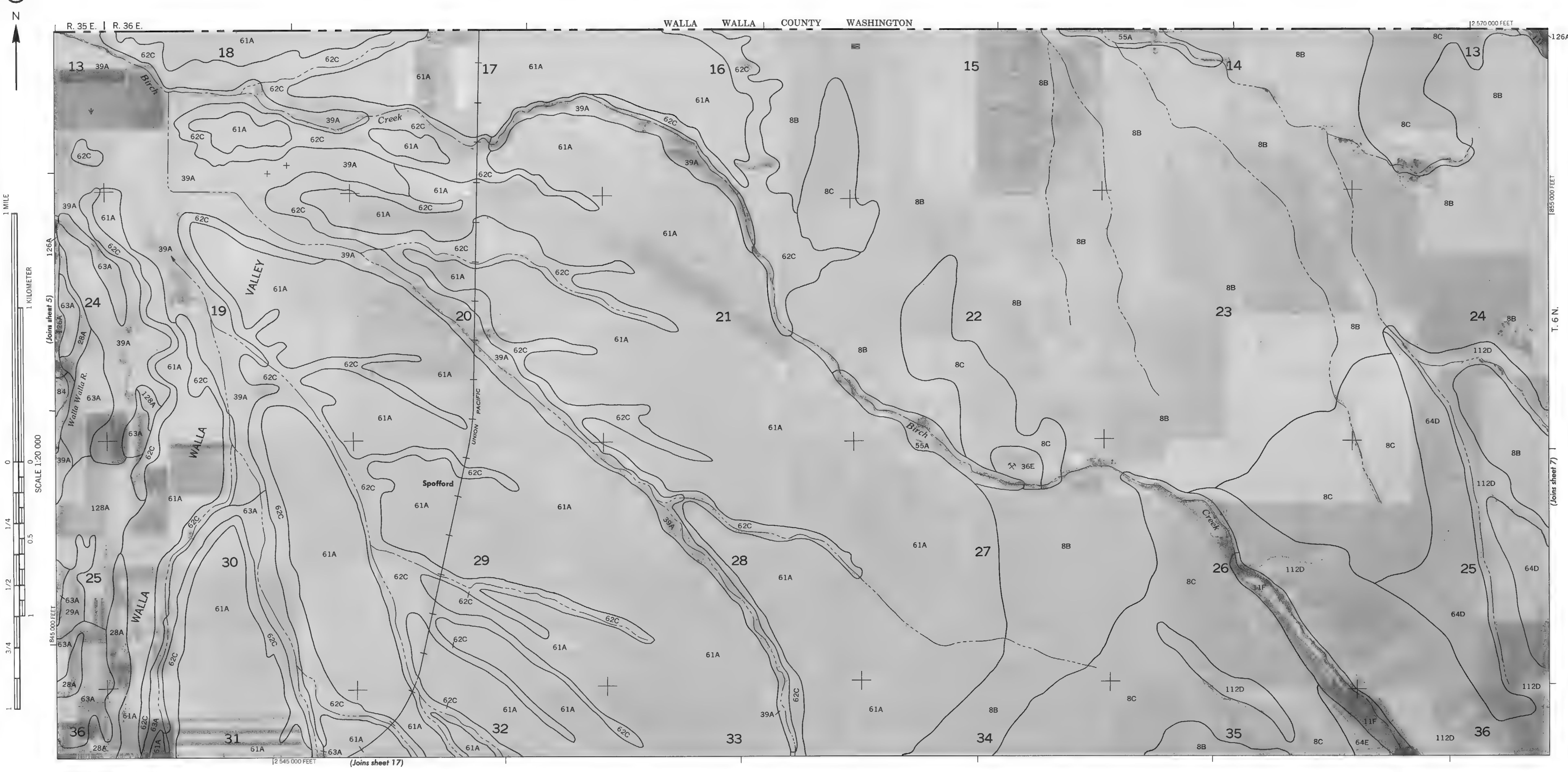
31
32
33
34
35
80C
80D
80B
82E
81E
48E
24B
27A
43A
60F
25C
54E
114B
115D
114C
115D
49F


4
N
R. 33 E. | R. 34 E.
WALLA WALLA COUNTY WASHINGTON
2 505 000 FEET
855 000 FEET
T. 6 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 15)
2 480 000 FEET
845 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
WALLA
WALLA
VALLEY
White Reservoir
WHITE DITCH
Pine Creek
Swartz Creek
South Branch
Mud Creek
Dry Creek
WHITE DITCH
DITCH
Pine
13 18 17 16 15 14 13
24 19 20 21 22 23 24
25 30 29 28 27 26 25
36 31 32 33 34 35 36


R. 34 E. | R. 35 E. 2 510 000 FEET
WALLA WALLA COUNTY WASHINGTON
N
855 000 FEET
T. 6 N.
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 16)
2 540 000 FEET
845 000 FEET
WALLA WALLA VALLEY
Umapine
Ferndale
South Branch
Mud Creek
Johnson Creek
Dry Creek
HUDSON BAY CANAL
WHITE DITCH
West Prong
Little Walla Walla River
East Prong Little Walla Walla River
Big Spring Branch
Grandview Creek
Walla Walla River
West Crockett Branch
East Ford Branch
1 MILE
1 KILOMETER
SCALE 1:20 000


6
N
R. 35 E.
R. 36 E.
WALLA WALLA COUNTY WASHINGTON
2 570 000 FEET
855 000 FEET
845 000 FEET
2 545 000 FEET
T. 6 N.
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 17)
1 MILE
1 KILOMETER
SCALE 1:20 000
Birch Creek
WALLA WALLA VALLEY
Walla Walla R.
UNION PACIFIC
Spofford
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
8B
8C
11F
28A
29A
36E
39A
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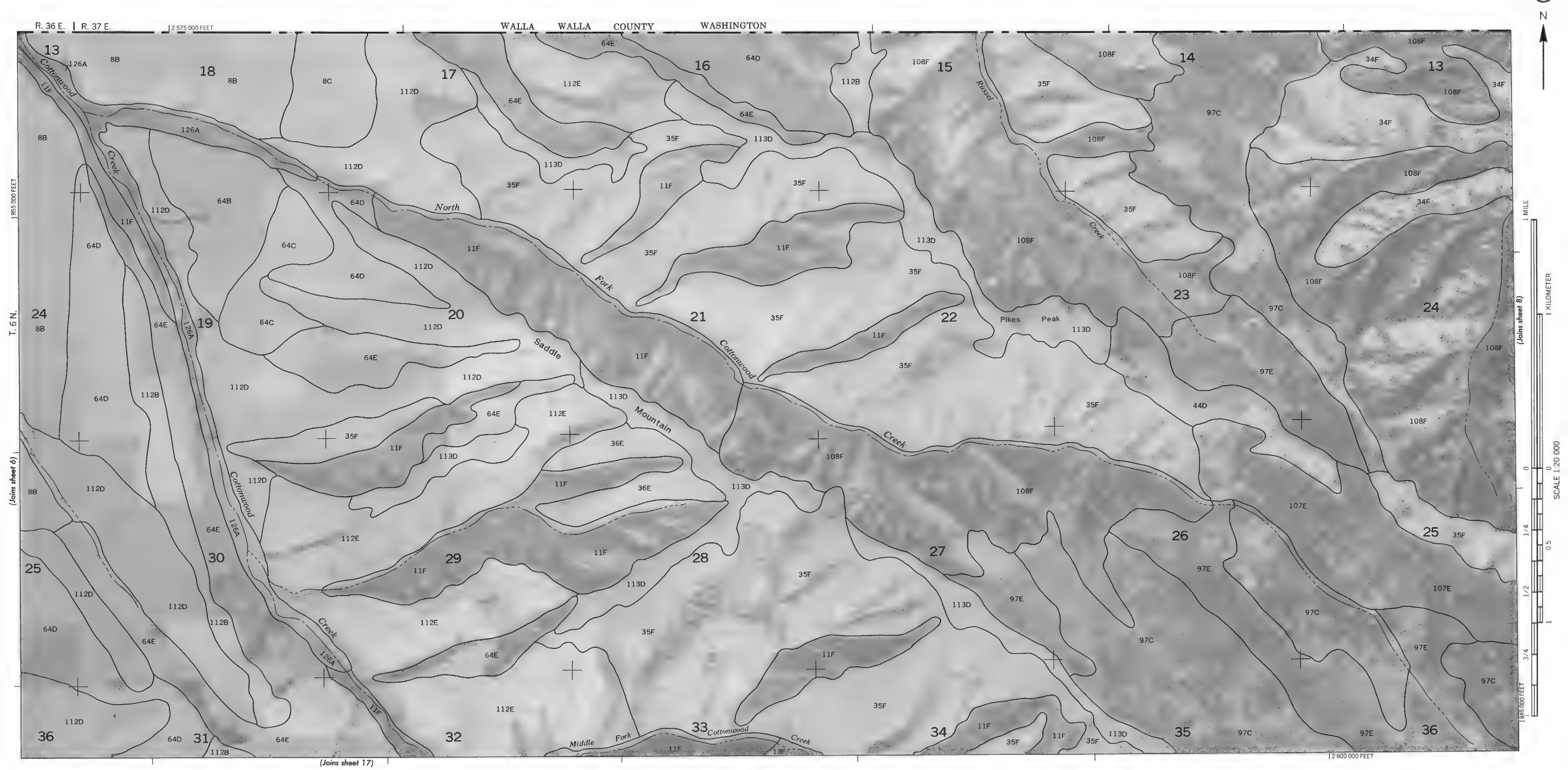
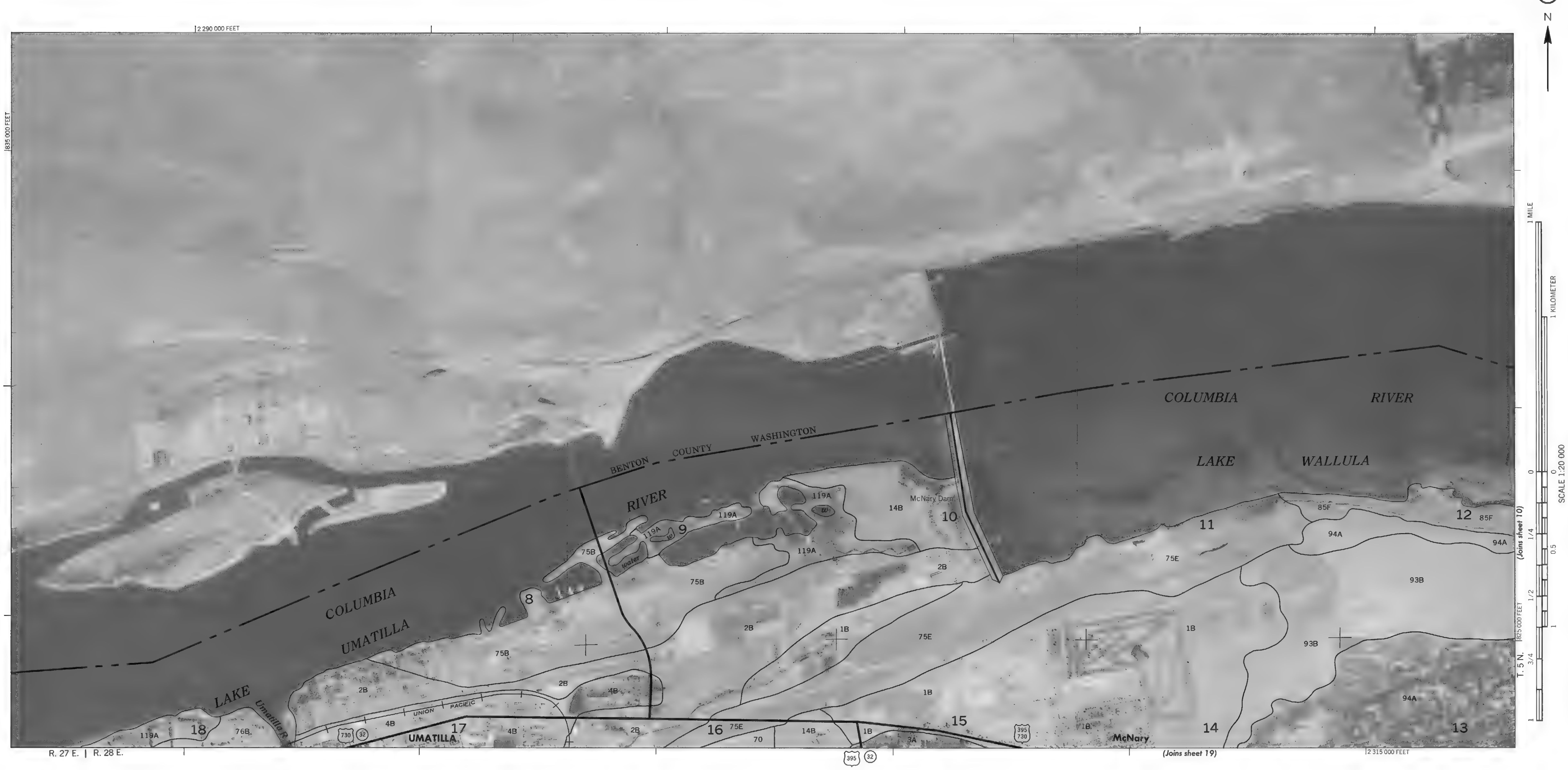
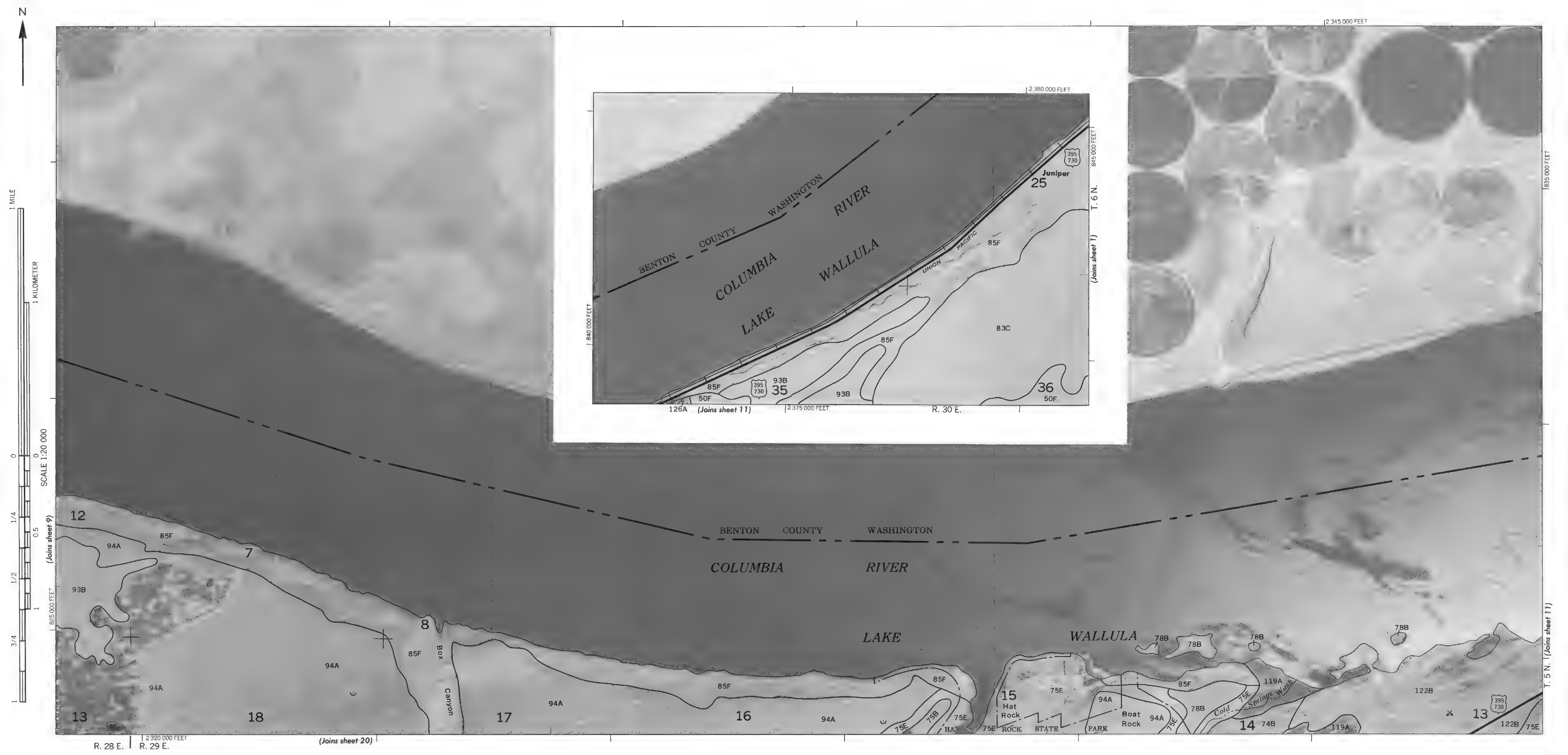
61A
62C
63A
64D
64E
84
112D
126A
128A

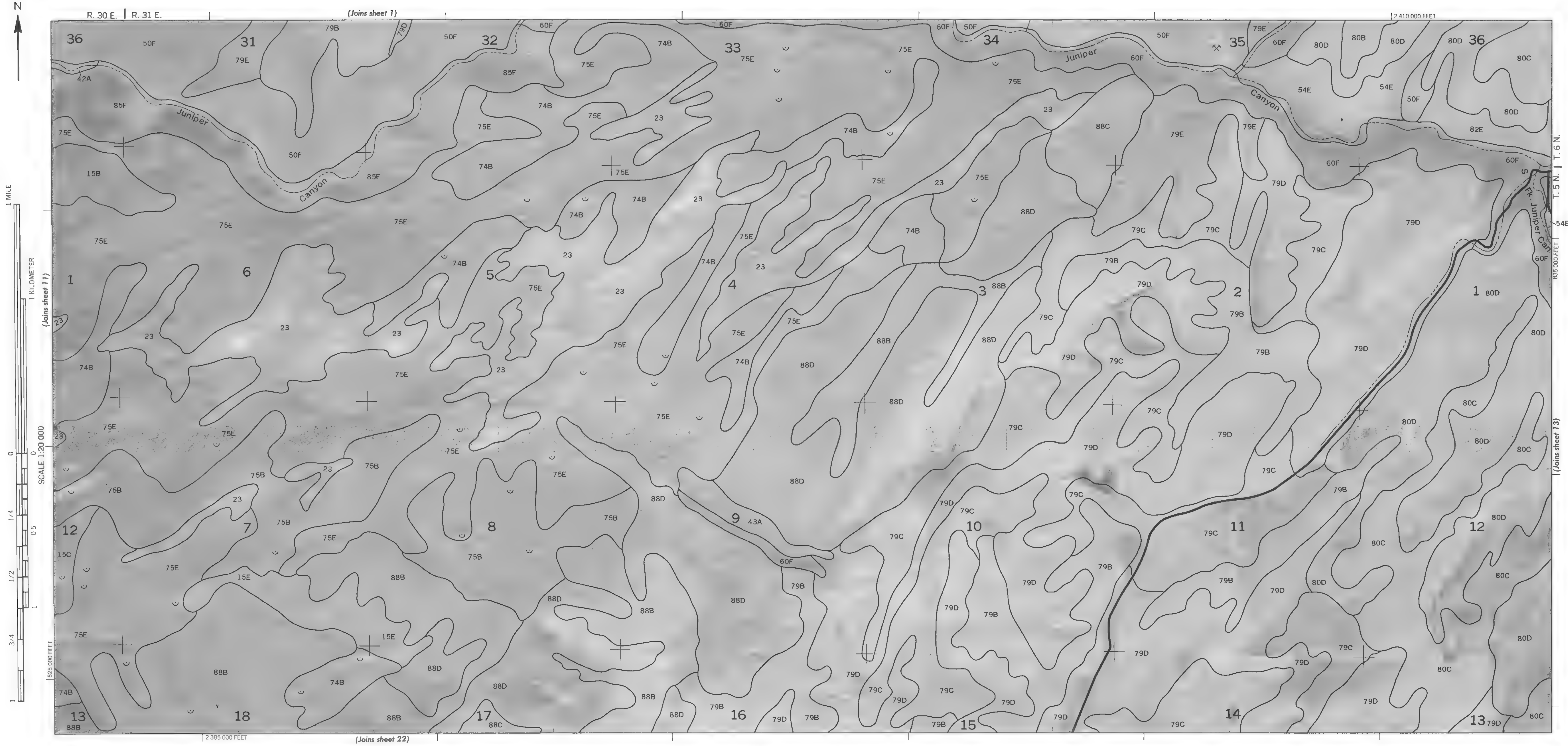

7
N
R. 36 E.
R. 37 E.
2 575 000 FEET
WALLA WALLA COUNTY
WASHINGTON
T. 6 N.
855 000 FEET
845 000 FEET
2 600 000 FEET
(Joins sheet 6)
(Joins sheet 8)
(Joins sheet 17)
North Fork Cottonwood Creek
Cottonwood Creek
Middle Fork Cottonwood Creek
Russel Creek
Saddle Mountain
Pikes Peak
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
8B
8C
11F
13F
34F
35F
36E
44D
64B
64C
64D
64E
97C
97E
107E
108F
112B
112D
112E
113D
126A
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5

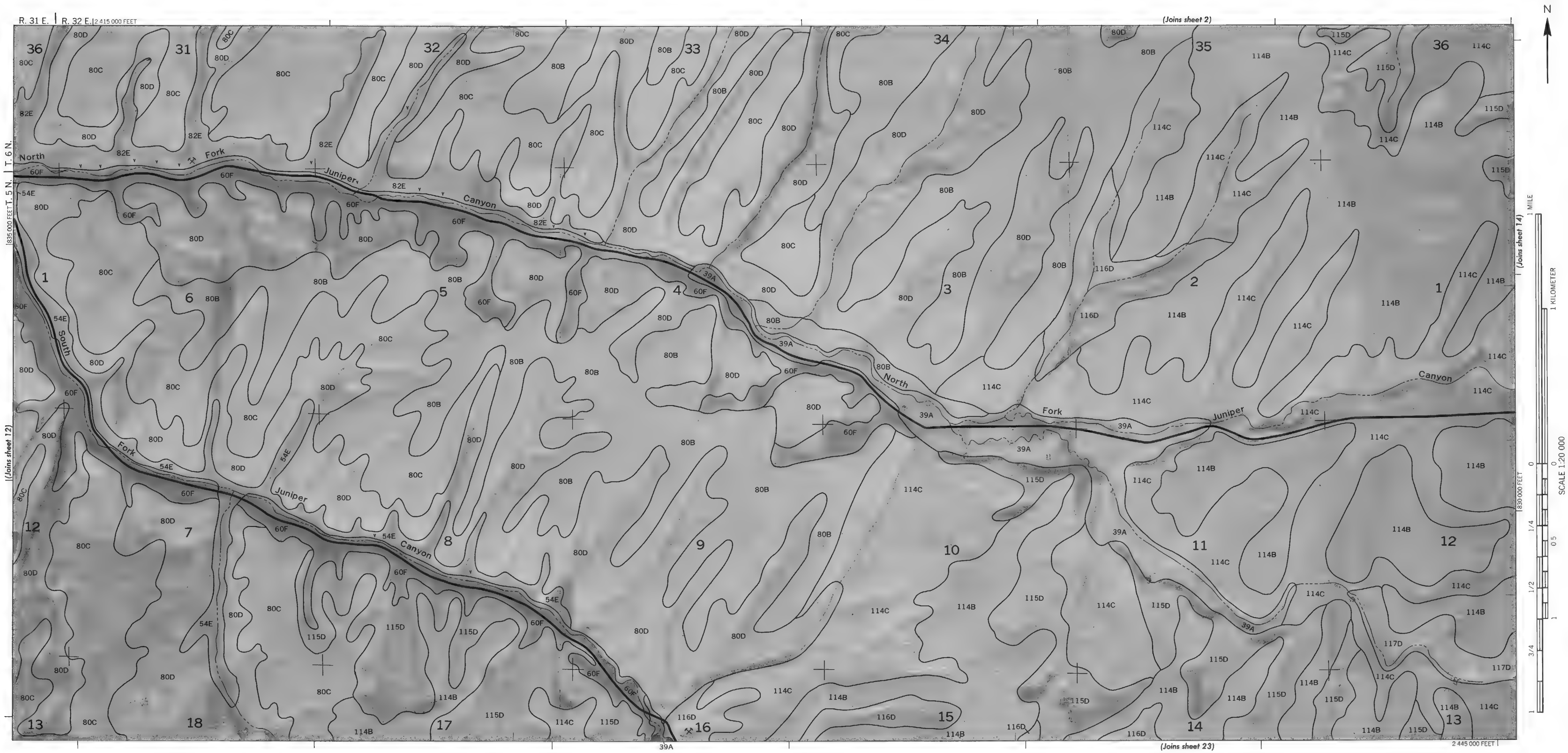

N
R. 37 E.
R. 38 E.
WALLA WALLA COUNTY WASHINGTON
2 635 000 FEET
860 000 FEET
(Joins sheet 7)
T. 6 N.
845 000 FEET
2 605 000 FEET
(Joins inset, sheet 29)
(Joins inset, sheet 29)
13
24
25
36
UMATILLA NATIONAL FOREST
UMATILLA NATIONAL FOREST
UMATILLA NAT FOR.
UMATILLA NAT. FOR.
U.N.F.
U.N.F.
U.N.F.
U.N.F.
LIMIT OF SOIL SURVEY
LIMIT OF SOIL SURVEY
LIMIT OF SOIL SURVEY
LIMIT OF SOIL SURVEY
LIMIT OF SOIL SURVEY
Mill Creek
Mill Creek
Webb Creek
Tiger Creek
Henry Canyon
35F
34F
108F
126A
107E
97C

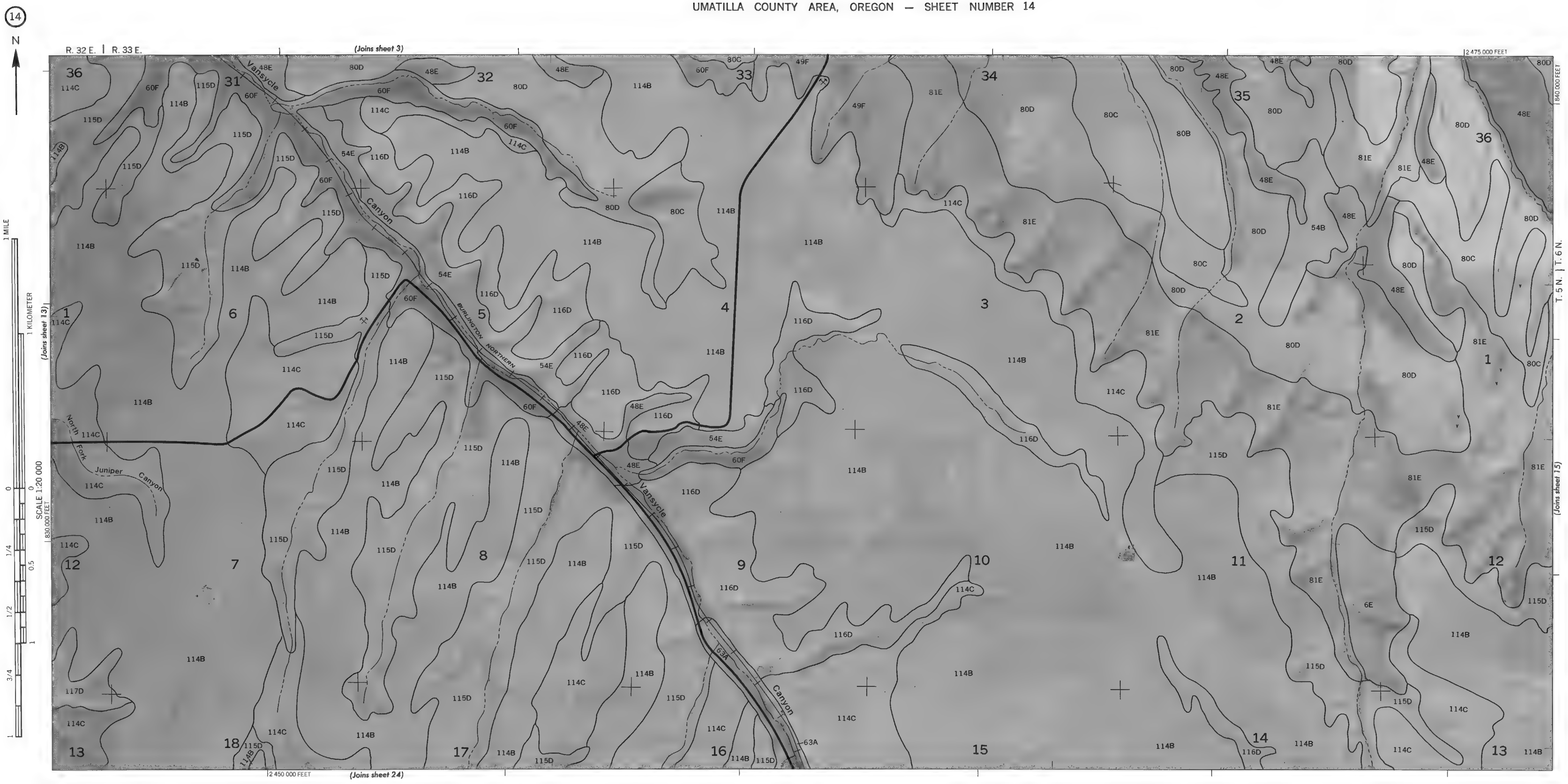

9
N
2 290 000 FEET
835 000 FEET
BENTON COUNTY WASHINGTON
COLUMBIA RIVER
LAKE WALLULA
COLUMBIA
UMATILLA
LAKE
RIVER
Umatilla R.
McNary Dam
water
w
119A
75B
2B
4B
14B
1B
75E
85F
94A
93B
3A
70
76B
8
9
10
11
12
13
14
15
16
17
18
UNION PACIFIC
UMATILLA
McNary
730
32
395
(Joins sheet 10)
(Joins sheet 19)
R. 27 E.
R. 28 E.
T. 5 N.
825 000 FEET
2 315 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5

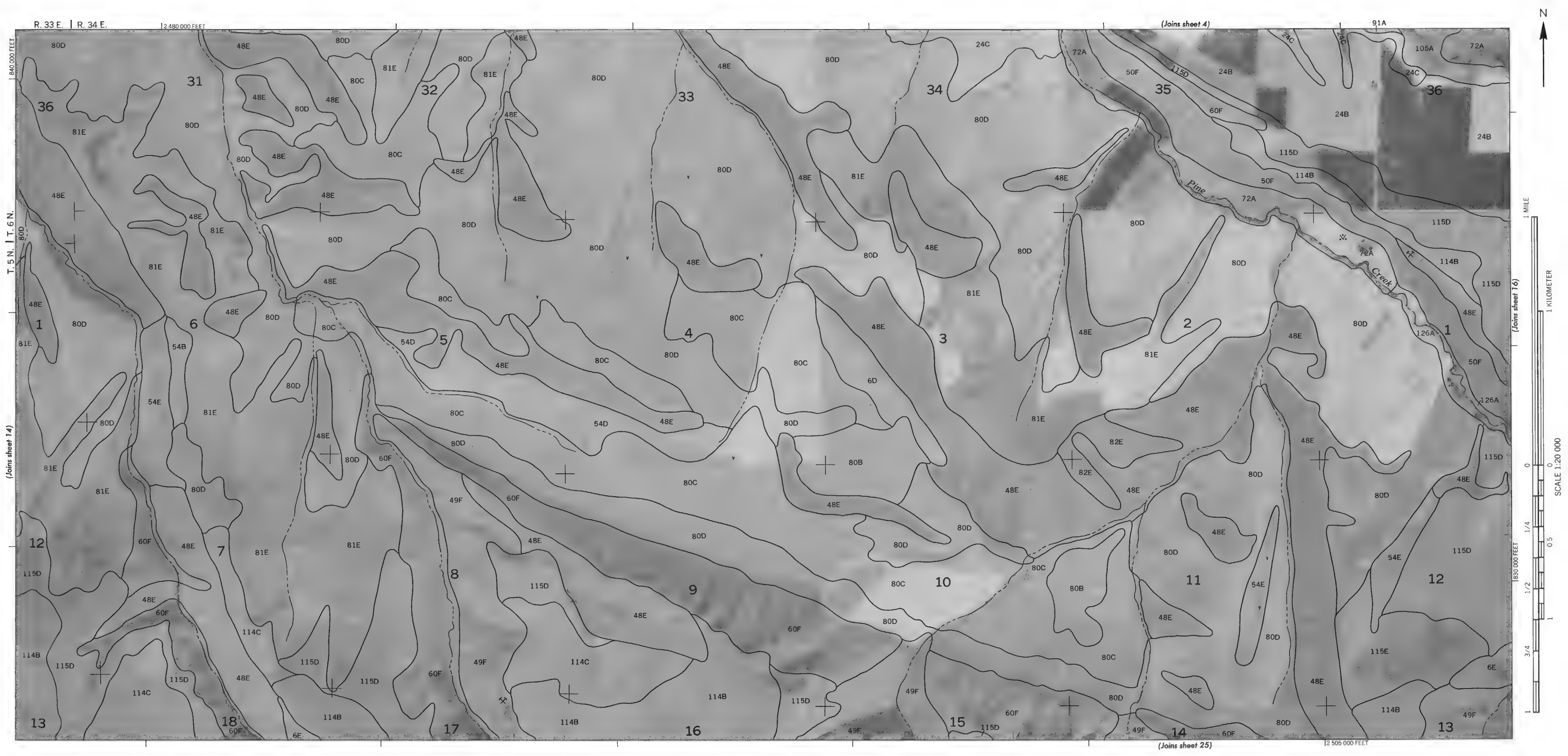

N
1 MILE
1 KILOMETER
SCALE 1:20 000
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 20)
(Joins sheet 1)
BENTON COUNTY WASHINGTON
COLUMBIA RIVER
LAKE WALLULA
UNION PACIFIC
Juniper
Box Canyon
Hat Rock
Boat Rock
HAT ROCK STATE PARK
Cold Springs Wash
R. 28 E.
R. 29 E.
R. 30 E.
T. 6 N.
T. 5 N.
2 320 000 FEET
2 345 000 FEET
2 375 000 FEET
2 380 000 FEET
825 000 FEET
835 000 FEET
840 000 FEET
845 000 FEET
12
7
8
13
18
17
16
15
14
25
35
36
85F
94A
93B
83C
50F
126A
78B
75E
75B
119A
122B
74B
395
730


2 350 000 FEET
(Joins inset, sheet 10)
835 000 FEET
COLUMBIA
RIVER
LAKE
WALLULA
BENTON
COUNTY
WASHINGTON
UNION
PACIFIC
Juniper
Canyon
T. 6 N.
T. 5 N.
(Joins sheet 12)
(Joins sheet 10)
(Joins sheet 21)
R. 29 E.
R. 30 E.
825 000 FEET
2 380 000 FEET
N
1 MILE
1 KILOMETER
SCALE 1:20 000

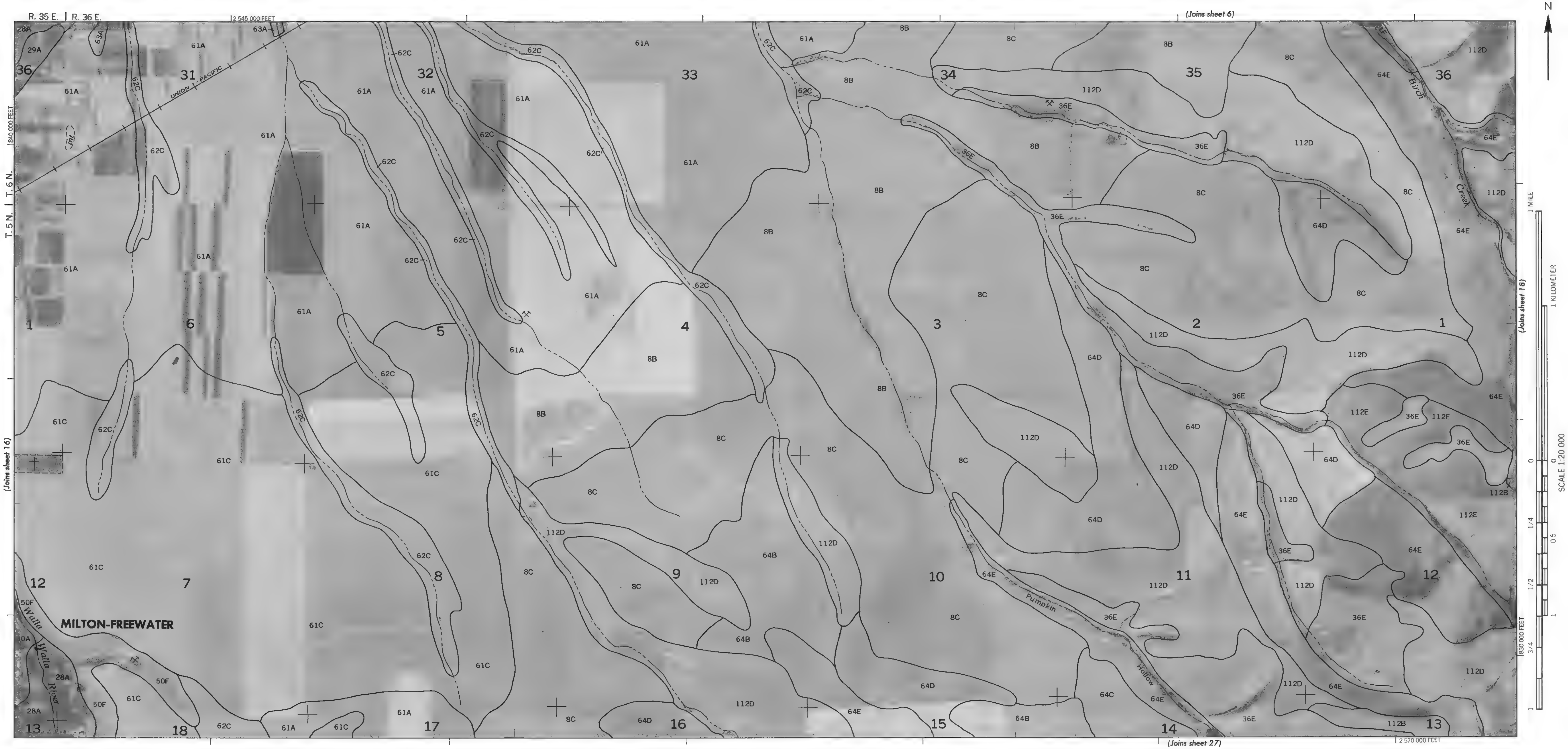

12
N
R. 30 E.
R. 31 E.
(Joins sheet 1)
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 22)
2 410 000 FEET
2 385 000 FEET
835 000 FEET
825 000 FEET
T. 6 N.
T. 5 N.
Juniper Canyon
Juniper Canyon
Juniper Canyon
S. Fk. Juniper Can
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
13
18
17
16
15
14
13
42A
85F
50F
79B
79E
79D
60F
74B
75E
23
15B
74B
88C
88D
88B
79C
79D
54E
80D
80B
80C
82E
75B
15C
15E
43A
88B
88D
88C


R. 31 E.
R. 32 E.
2 415 000 FEET
(Joins sheet 2)
N
T. 6 N.
T. 5 N.
835 000 FEET
(Joins sheet 12)
(Joins sheet 14)
North Fork Juniper Canyon
South Fork Juniper Canyon
North Fork Juniper Canyon
830 000 FEET
2 445 000 FEET
(Joins sheet 23)
1 MILE
1 KILOMETER
SCALE 1:20 000

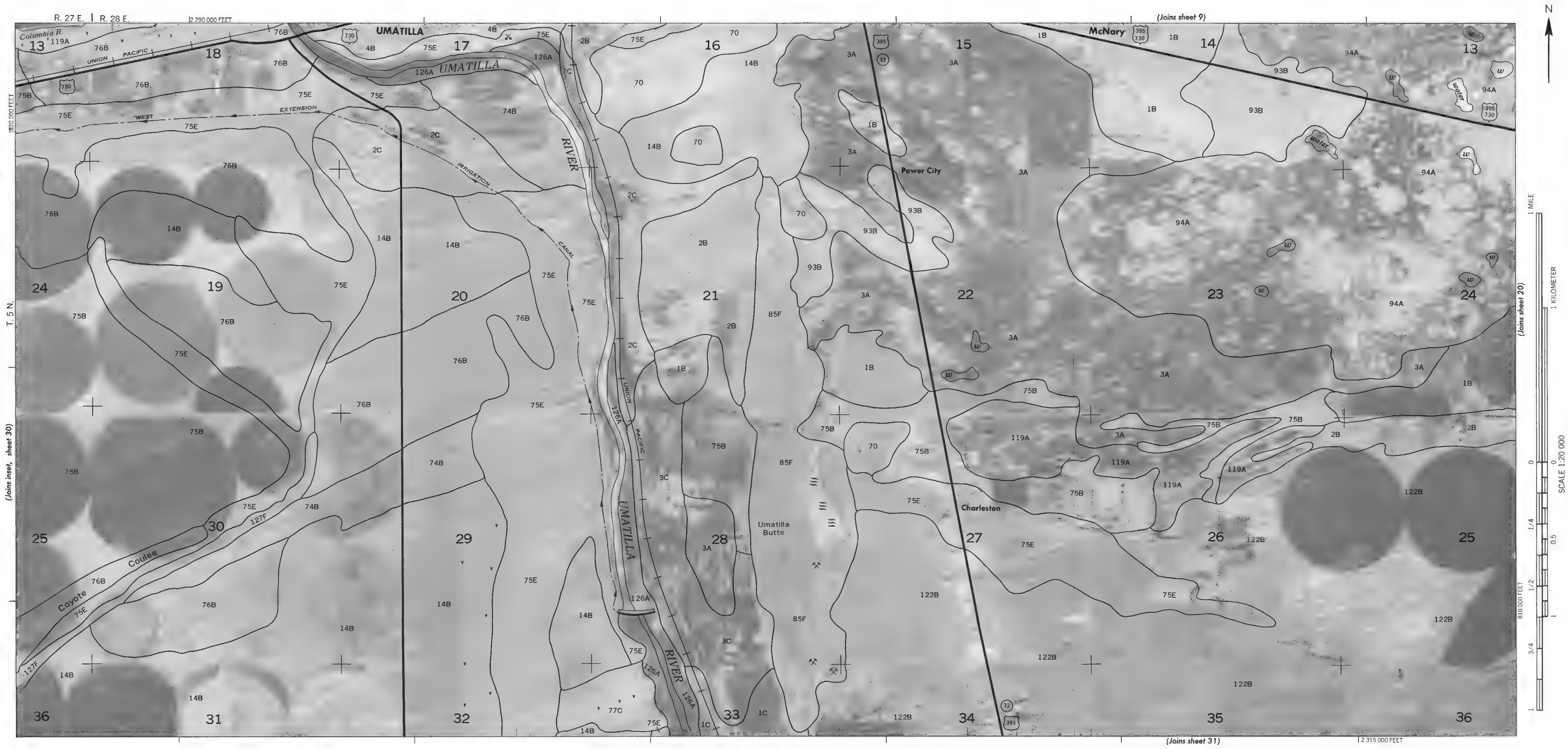

14
N
R. 32 E. | R. 33 E.
(Joins sheet 3)
2 475 000 FEET
840 000 FEET
T. 5 N. | T. 6 N.
(Joins sheet 15)
(Joins sheet 24)
2 450 000 FEET
(Joins sheet 13)
830 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
Vansycle
Canyon
BURLINGTON NORTHERN
North Fork Juniper Canyon
36
31
32
33
34
35
1
6
5
4
3
2
12
7
8
9
10
11
13
18
17
16
15
14

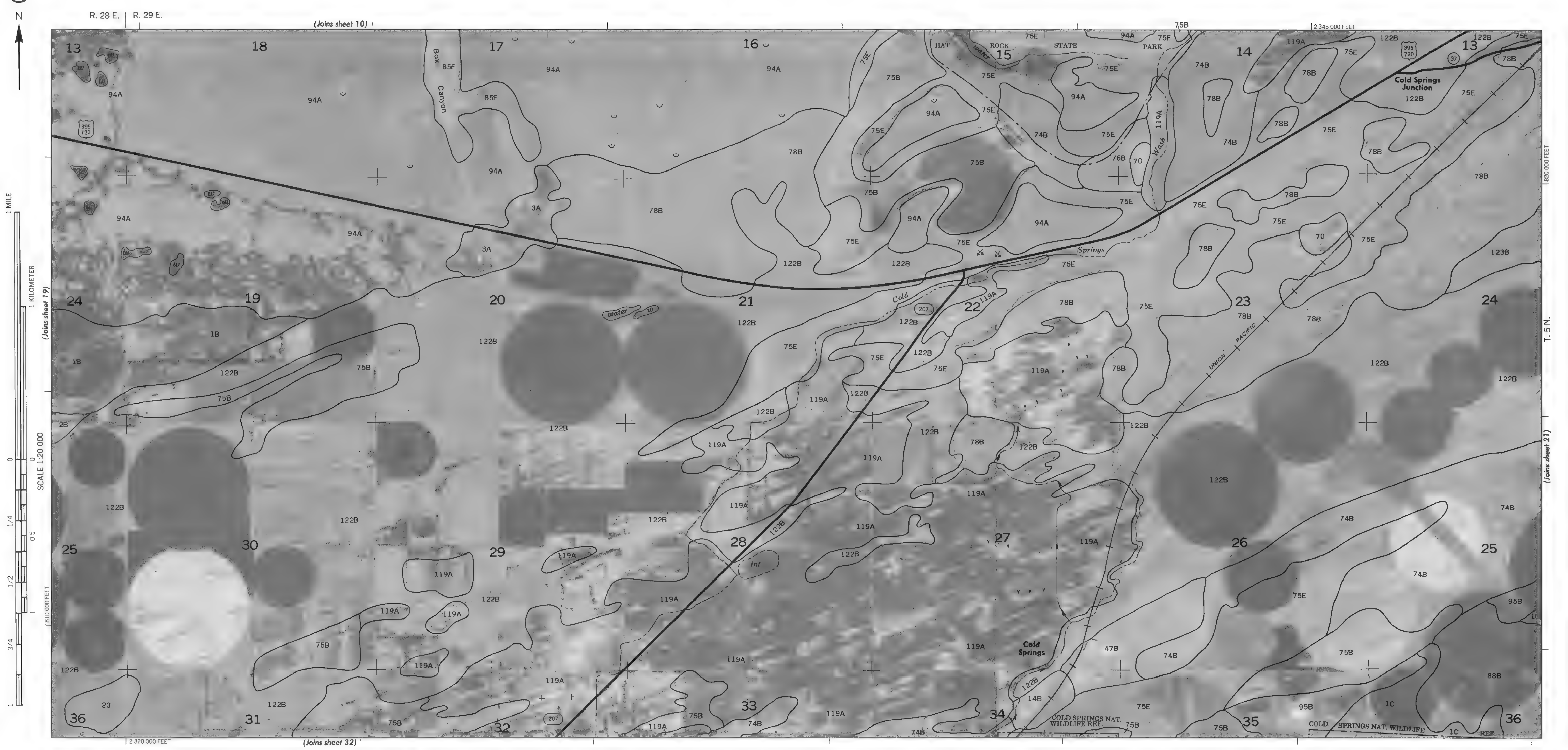

15
N
R. 33 E. | R. 34 E.
2 480 000 FEET
(Joins sheet 4)
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 25)
840 000 FEET
830 000 FEET
2 505 000 FEET
T. 6 N.
T. 5 N.
Pine Creek
1 MILE
1 KILOMETER
SCALE 1:20 000

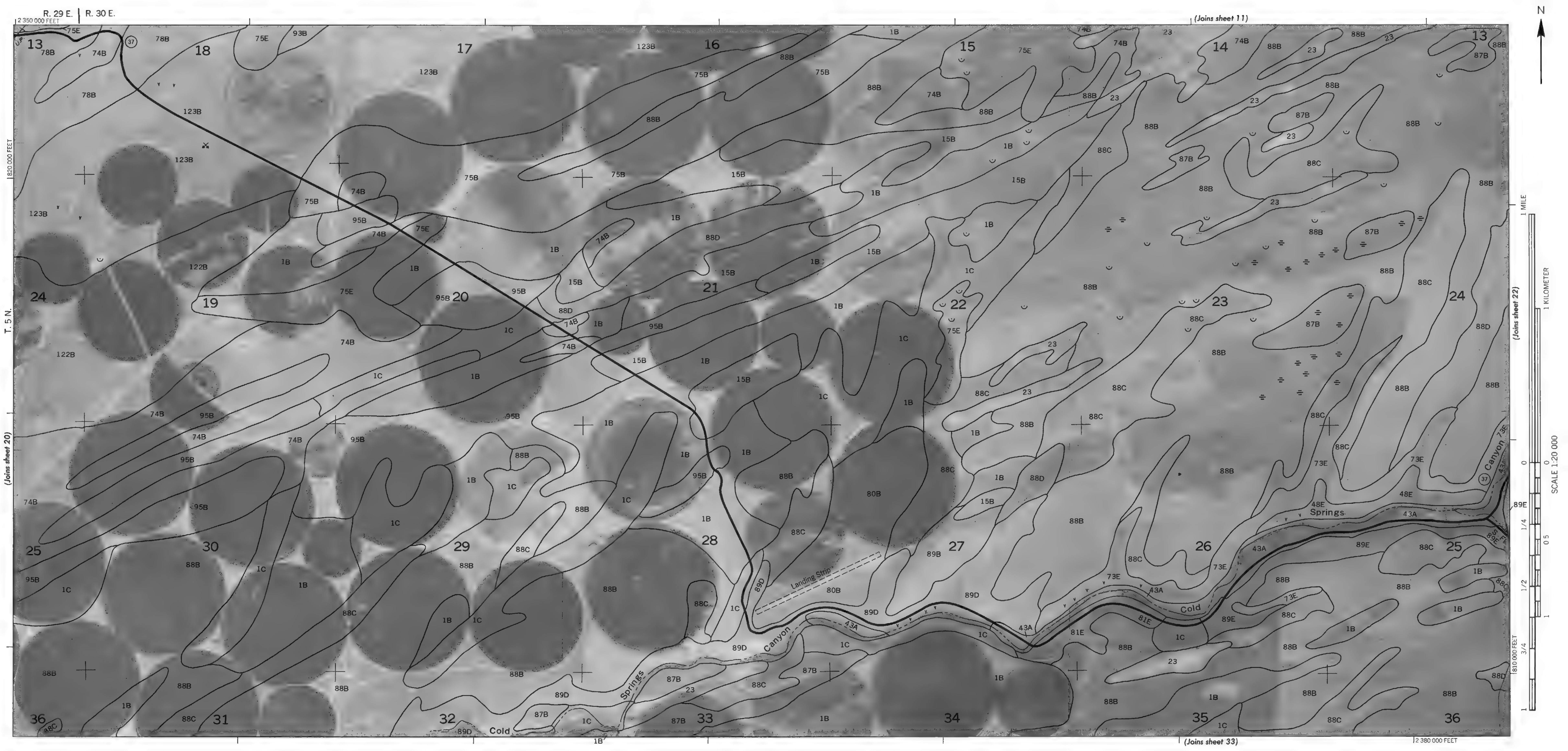

16
N
R. 34 E. | R. 35 E.
(Joins sheet 5)
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 26)
2 540 000 FEET
840 000 FEET
830 000 FEET
2 510 000 FEET
T. 6 N. | T. 5 N.
WALLA WALLA VALLEY
MILTON-FREEWATER
WHITE DITCH
HUDSON BAY CANAL
UNION PACIFIC
Dry Creek
Pine Creek
West Ford
Crockett Branch
Little Walla Walla
Walla Walla River
SCALE 1:20 000
1 MILE
1 KILOMETER


N
R. 35 E. | R. 36 E.
2 545 000 FEET
(Joins sheet 6)
T. 5 N. | T. 6 N.
840 000 FEET
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 27)
830 000 FEET
2 570 000 FEET
UNION PACIFIC
MILTON-FREEWATER
Walla Walla River
Pumpkin Hollow
Birch Creek
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
28A
29A
30A
50F
61A
61C
62C
63A
64B
64C
64D
64E
8B
8C
36E
112B
112D
112E
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
0.5
1

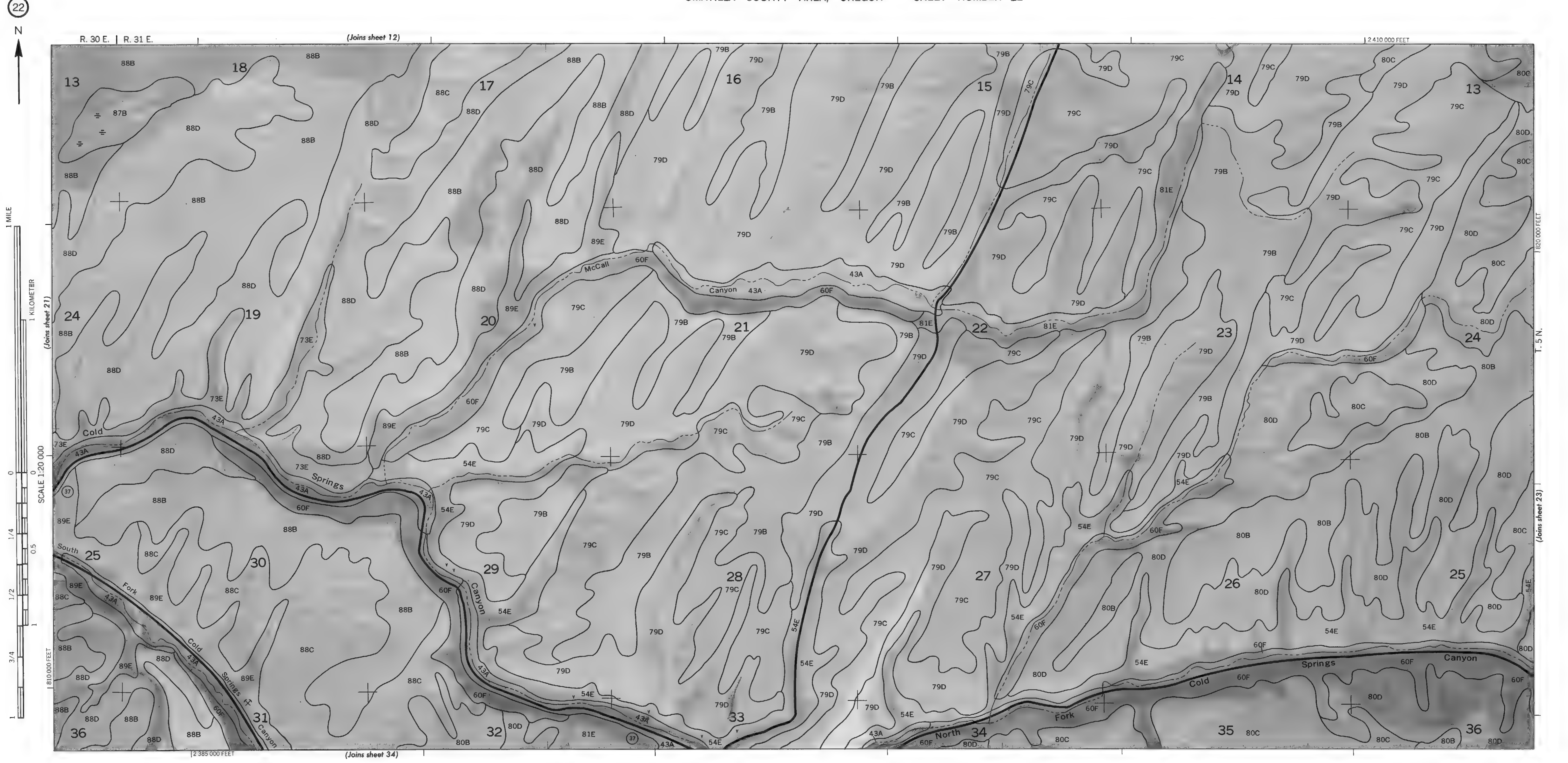

N
R. 36 E. | R. 37 E.
(Joins sheet 7)
2 600 000 FEET
T. 6 N.
T. 5 N.
840 000 FEET
(Joins sheet 17)
(Joins inset, sheet 29)
(Joins sheet 28)
2 575 000 FEET
830 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
M. Fk. Cottonwood Cr.
Middle Fork Cottonwood Creek
South Fork Cottonwood Creek
Birch Creek
Pine Ridge
Little Meadows

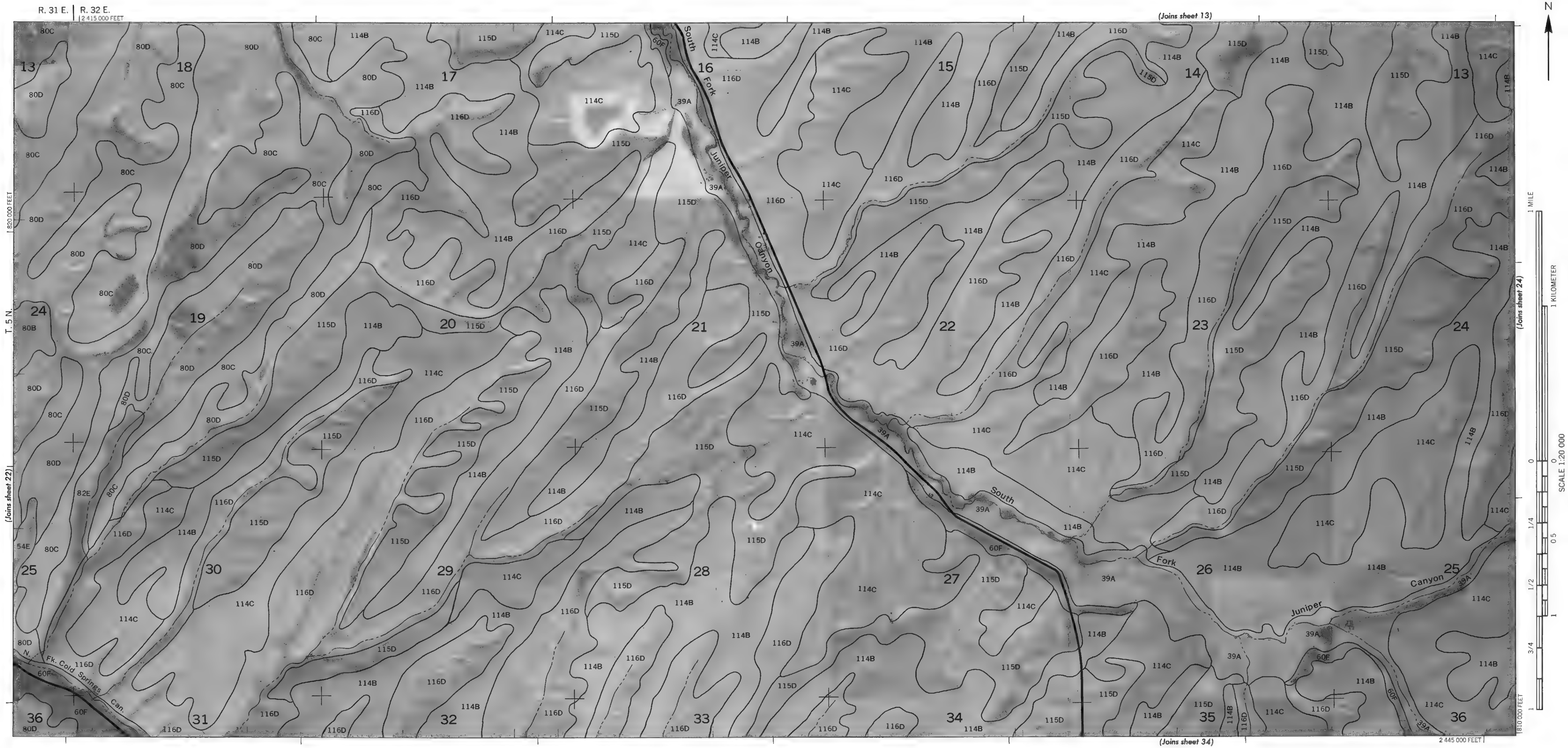

19
N
R. 27 E.
R. 28 E.
2 290 000 FEET
(Joins sheet 9)
UMATILLA
McNary
Columbia R.
UMATILLA
RIVER
IRRIGATION
CANAL
WEST
EXTENSION
UNION PACIFIC
Power City
Charleston
Umatilla Butte
Coyote Coulee
T. 5 N.
(Joins inset, sheet 30)
(Joins sheet 20)
(Joins sheet 31)
2 315 000 FEET
810 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000

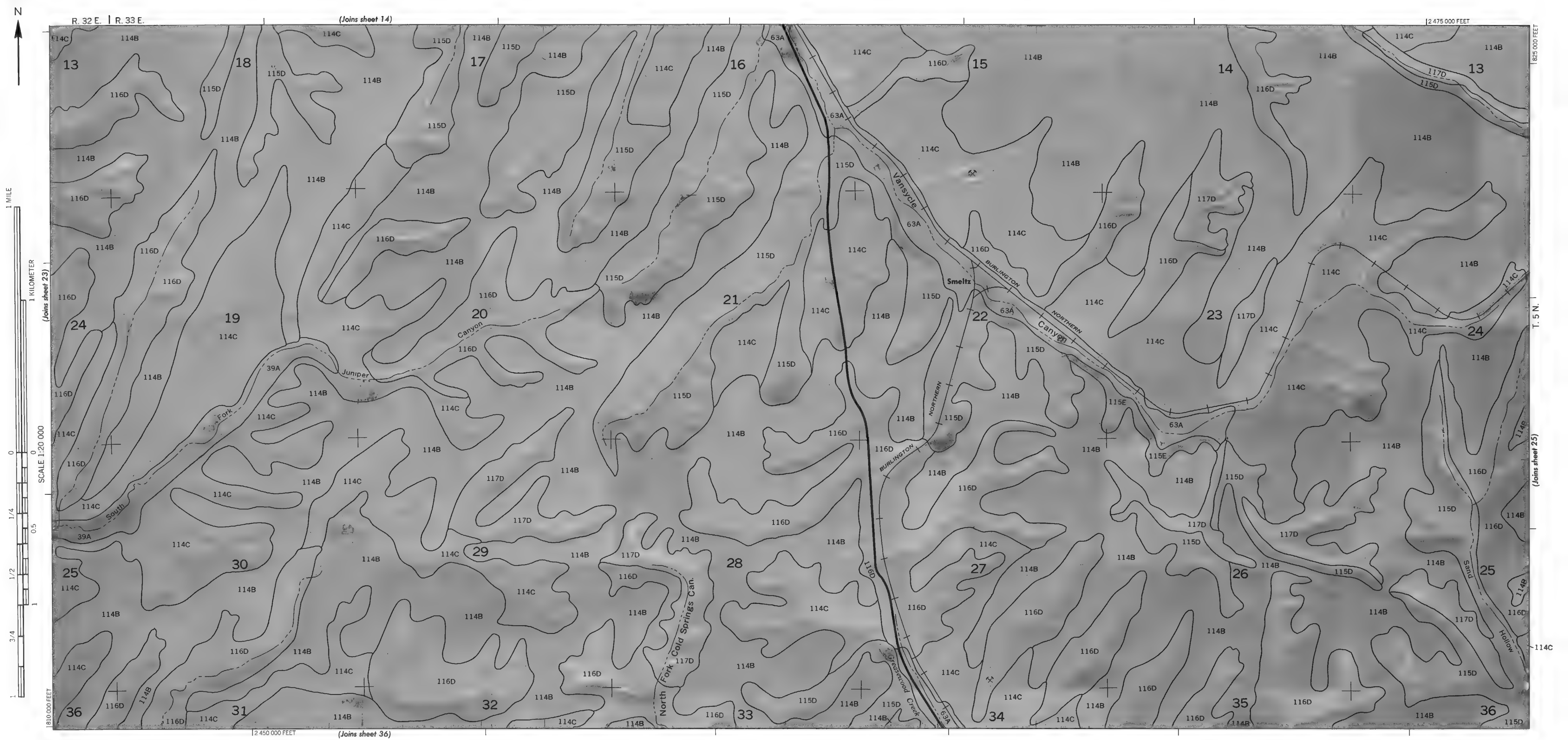

20
N
R. 28 E.
R. 29 E.
(Joins sheet 10)
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 32)
2 345 000 FEET
2 320 000 FEET
820 000 FEET
810 000 FEET
T. 5 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
Box Canyon
HAT ROCK STATE PARK
Cold Springs Junction
Cold Springs
Wash
UNION PACIFIC
COLD SPRINGS NAT. WILDLIFE REF.
COLD SPRINGS NAT. WILDLIFE REF

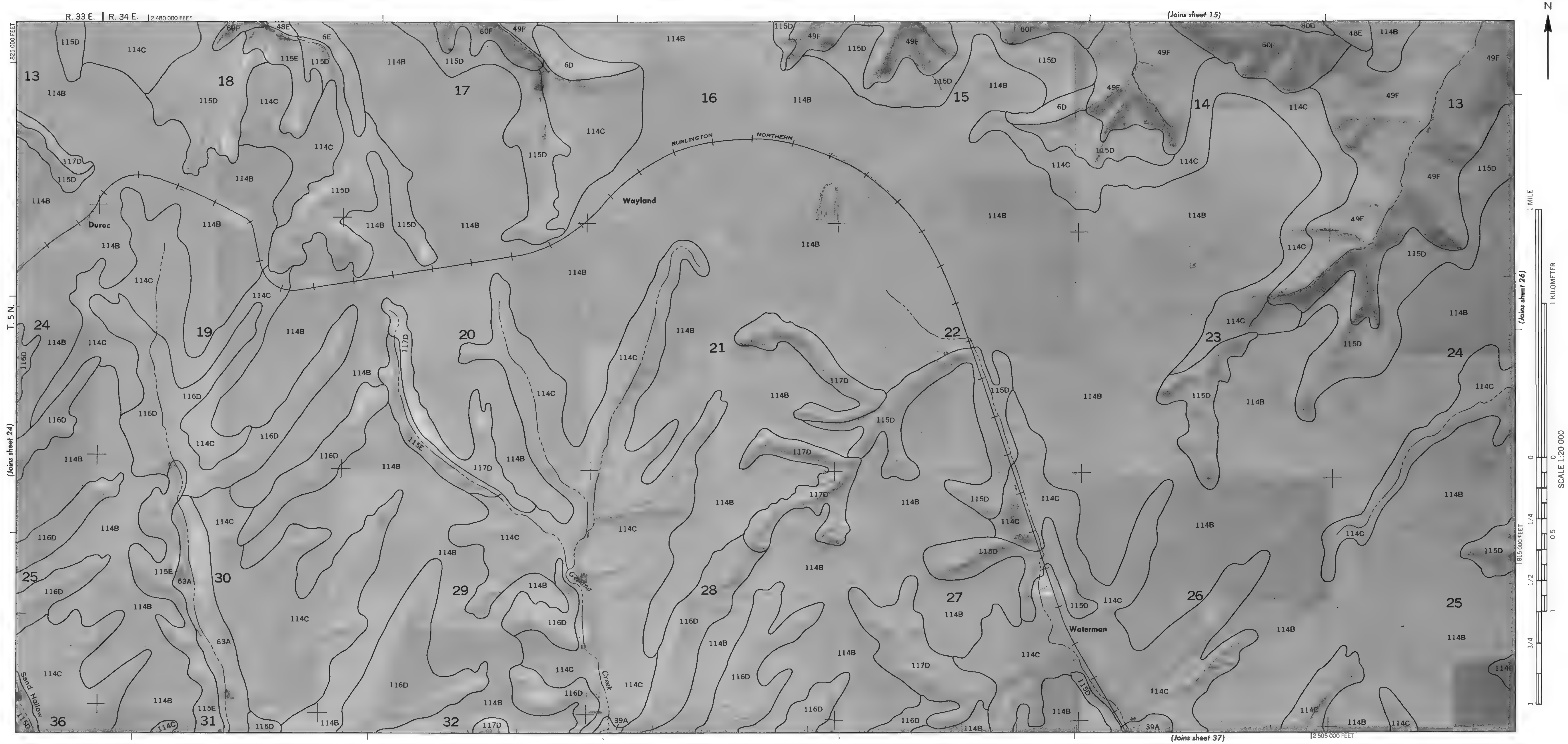


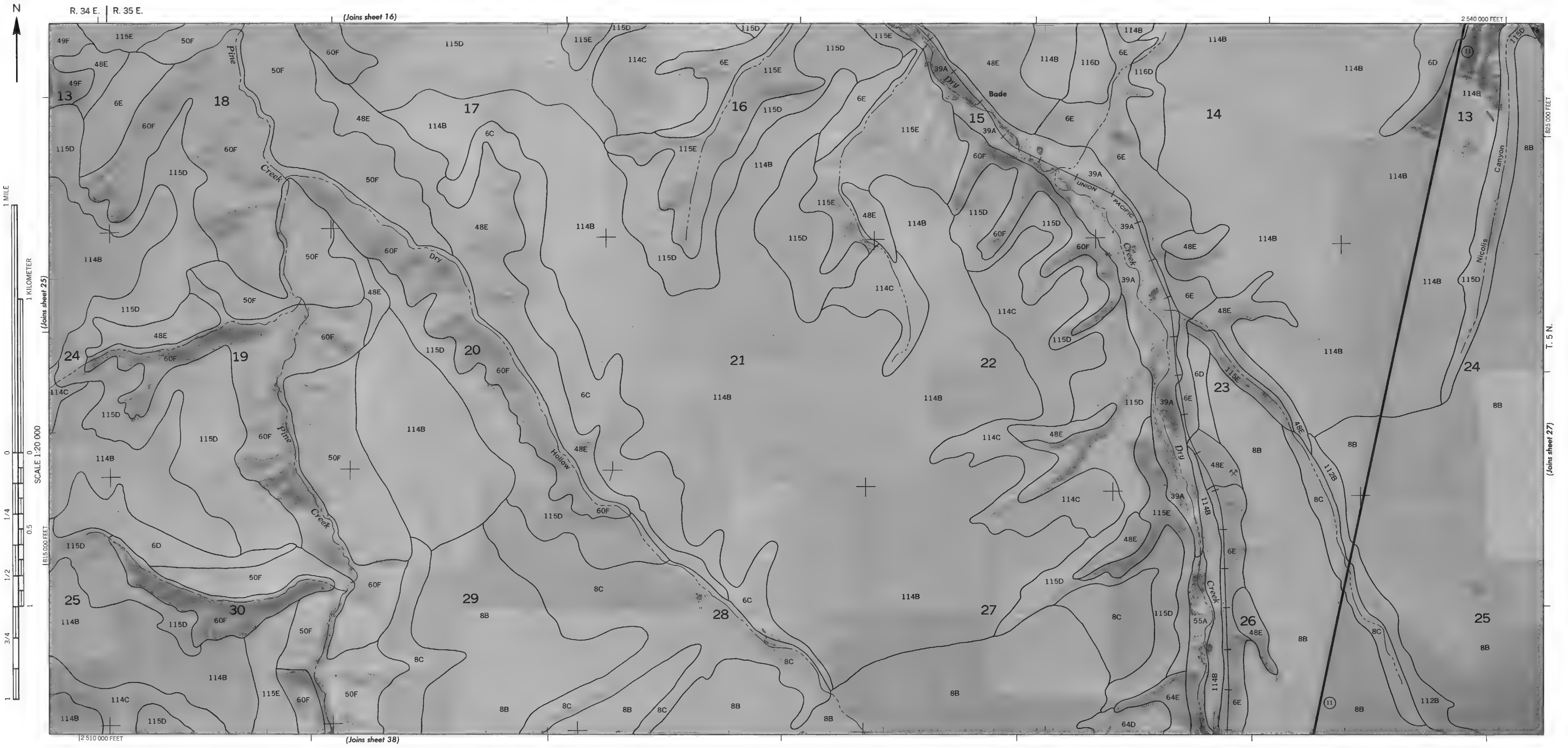
21
N
R. 29 E.
R. 30 E.
2 350 000 FEET
(Joins sheet 11)
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 33)
820 000 FEET
810 000 FEET
2 380 000 FEET
T. 5 N.
Landing Strip
Cold Springs Canyon
Springs
Canyon
Cold
1 MILE
1 KILOMETER
SCALE 1:20 000

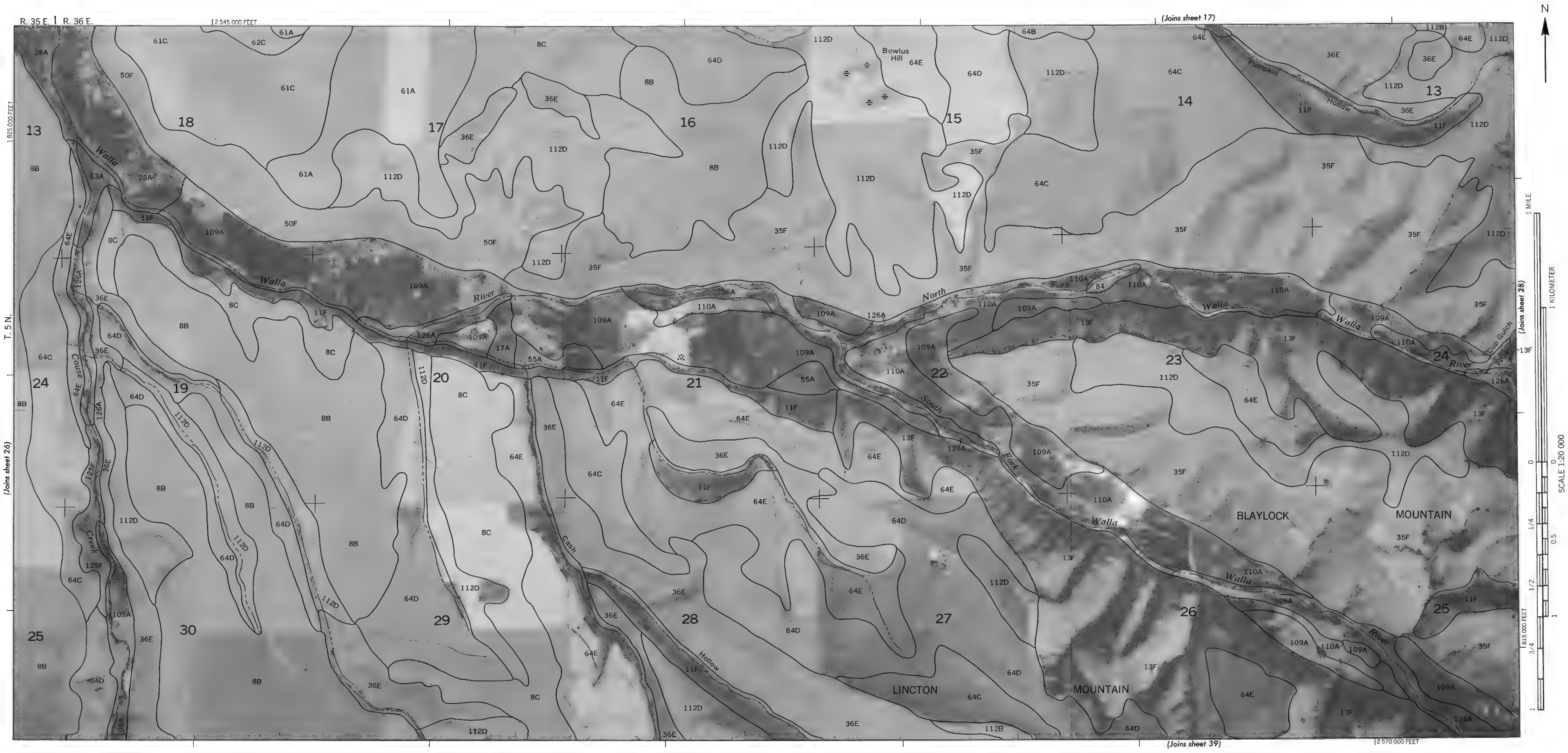

22
N
R. 30 E. | R. 31 E.
(Joins sheet 12)
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 34)
T. 5 N.
2 410 000 FEET
820 000 FEET
810 000 FEET
2 385 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
McCall Canyon
Cold Springs Canyon
South Fork Cold Springs Canyon
North Fork Cold Springs Canyon
37

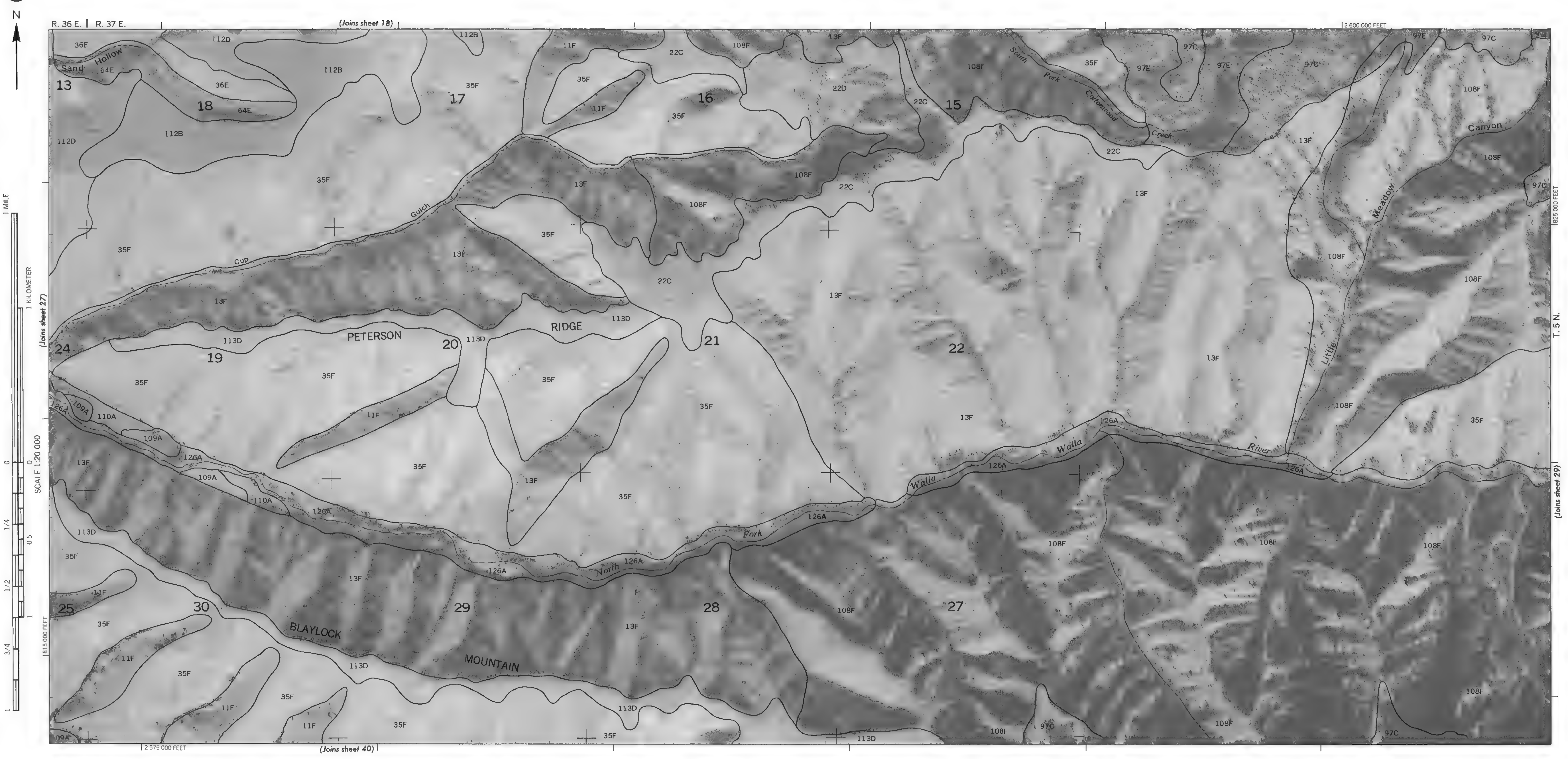

R. 31 E.
R. 32 E.
2 415 000 FEET
(Joins sheet 13)
(Joins sheet 24)
(Joins sheet 22)
(Joins sheet 34)
T. 5 N.
820 000 FEET
810 000 FEET
2 445 000 FEET
N
South Fork Juniper Canyon
N. Fk. Cold Springs Can.
1 MILE
1 KILOMETER
SCALE 1:20 000


N
R. 32 E.
R. 33 E.
(Joins sheet 14)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 36)
2 475 000 FEET
825 000 FEET
810 000 FEET
2 450 000 FEET
T. 5 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
Vansycle
Canyon
BURLINGTON
NORTHERN
Smeltz
Juniper
Canyon
South
Fork
North
Fork
Cold Springs Can.
Greasewood
Creek
Sand
Hollow
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
114B
114C
115D
115E
116D
117D
39A
63A

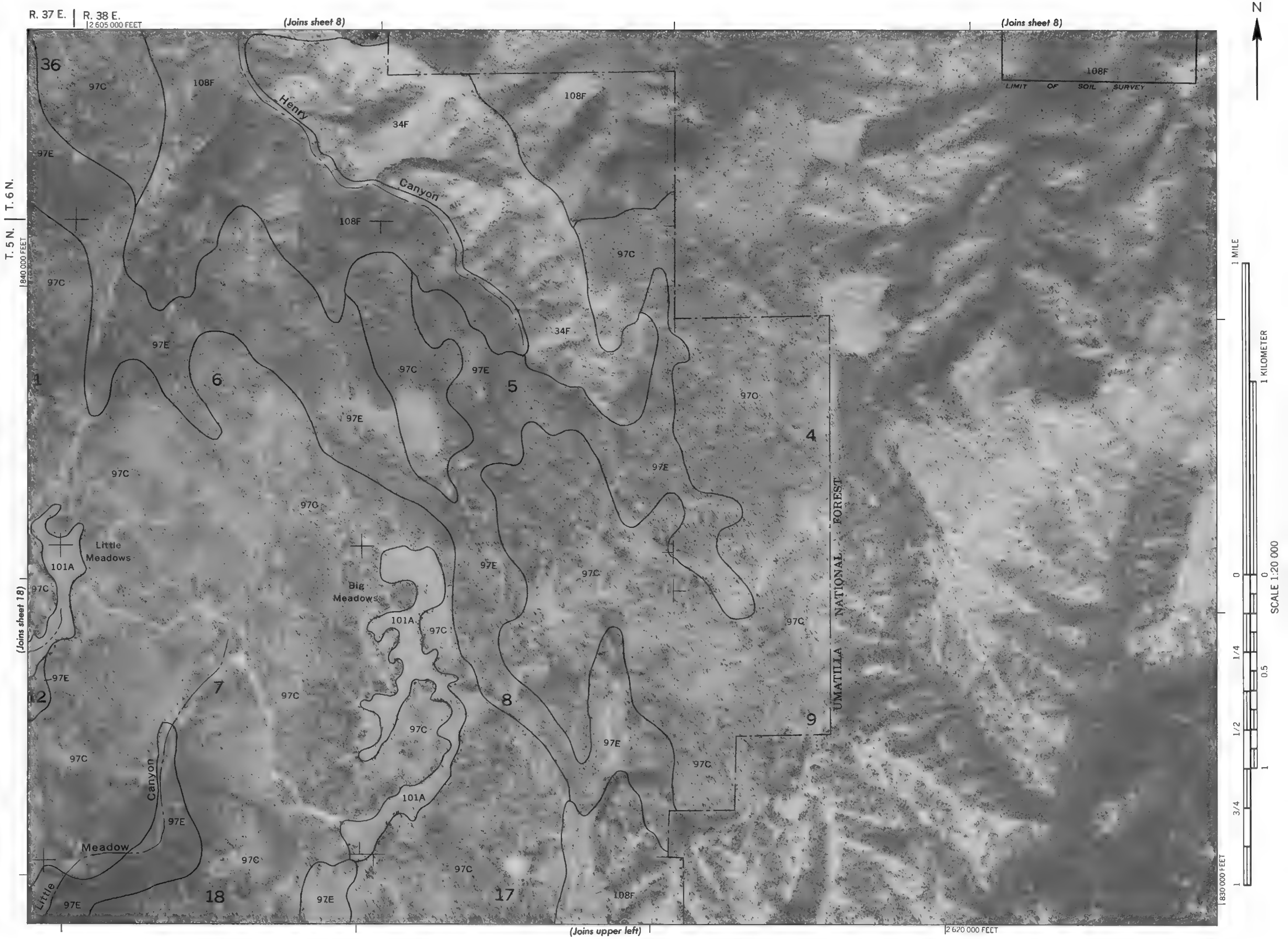

25
N
R. 33 E.
R. 34 E.
2 480 000 FEET
(Joins sheet 15)
825 000 FEET
T. 5 N.
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 37)
2 505 000 FEET
815 000 FEET
Duroc
Wayland
Waterman
BURLINGTON
NORTHERN
Sand Hollow
Creek
1 MILE
1 KILOMETER
SCALE 1:20 000


N
R. 34 E.
R. 35 E.
(Joins sheet 16)
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 38)
T. 5 N.
2 510 000 FEET
2 540 000 FEET
815 000 FEET
825 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
Pine Creek
Dry Creek
Dry Hollow
Bade
UNION PACIFIC
Nicolls Canyon

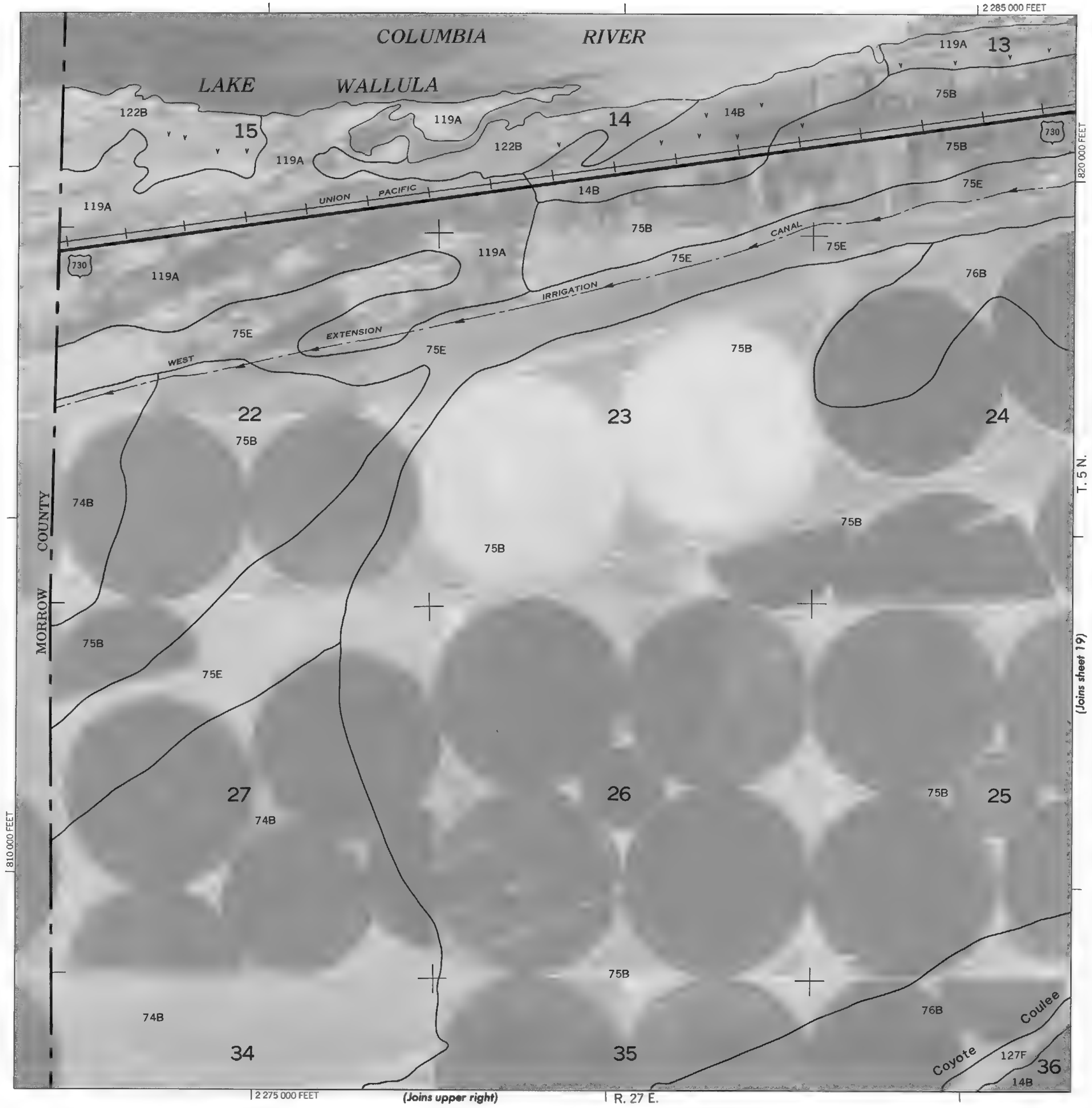

R. 35 E. | R. 36 E.
2 545 000 FEET
(Joins sheet 17)
825 000 FEET
T. 5 N.
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 39)
815 000 FEET
2 570 000 FEET
N
1 MILE
1 KILOMETER
SCALE 1:20 000
Bowlus Hill
Pumpkin Hollow
Walla Walla River
North Fork Walla Walla River
South Fork Walla Walla River
Couse Creek
Cash Hollow
Cup Gulch
BLAYLOCK MOUNTAIN
LINCTON MOUNTAIN
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
8B
8C
11F
13F
17A
28A
35F
36E
50F
55A
61A
61C
62C
63A
64B
64C
64D
64E
84
109A
110A
112B
112D
125F
126A

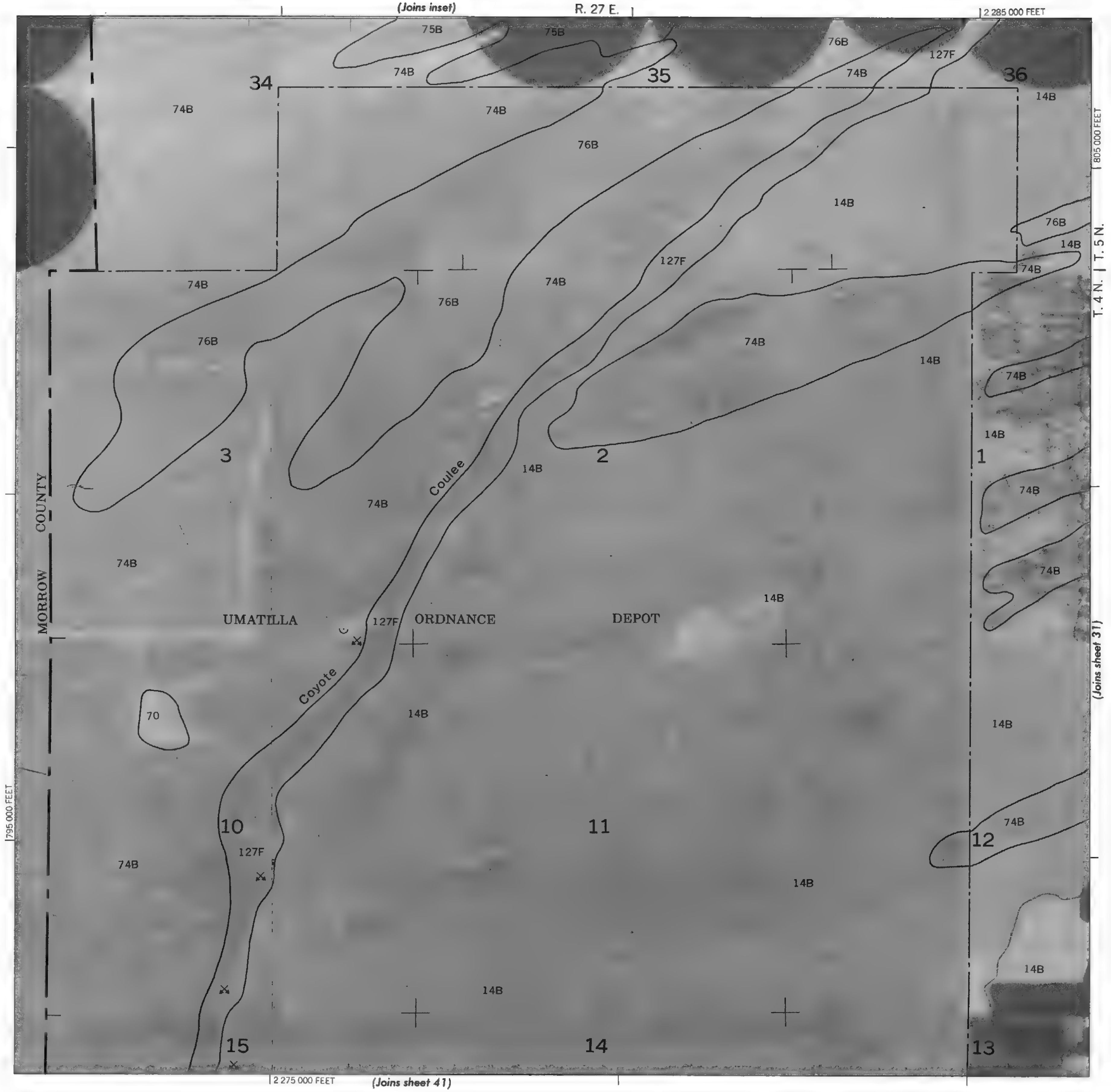

N
R. 36 E.
R. 37 E.
(Joins sheet 18)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 40)
2 600 000 FEET
2 575 000 FEET
825 000 FEET
815 000 FEET
T. 5 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
Sand Hollow
Cup Gulch
PETERSON RIDGE
BLAYLOCK MOUNTAIN
South Fork Cottonwood Creek
Little Meadow Canyon
Walla Walla River
North Fork
13
15
16
17
18
19
20
21
22
24
25
27
28
29
30
36E
64E
112B
112D
11F
13F
22C
22D
35F
97C
97E
108F
109A
110A
113D
126A


R. 37 E. | R. 38 E.
2 605 000 FEET
(Joins inset)
T. 5 N.
825 000 FEET
(Joins sheet 28)
Little Meadow Canyon
Big Meadow Canyon
18
17
19
20
30
101A
97C
97E
108F
35F
North Fork Walla Walla River
UMATILLA NATIONAL FOREST
BLAYLOCK MOUNTAIN
815 000 FEET
2 615 000 FEET
(Joins inset, sheet 52)


R. 37 E. | R. 38 E.
2 605 000 FEET
(Joins sheet 8)
LIMIT OF SOIL SURVEY
T. 6 N.
T. 5 N.
840 000 FEET
(Joins sheet 18)
Henry Canyon
Little Meadows
Big Meadows
Little Meadow Canyon
36
1
6
5
4
7
8
9
12
18
17
97C
97E
108F
34F
101A
UMATILLA NATIONAL FOREST
830 000 FEET
2 620 000 FEET
(Joins upper left)
29
N
1 MILE
1 KILOMETER
SCALE 1:20 000

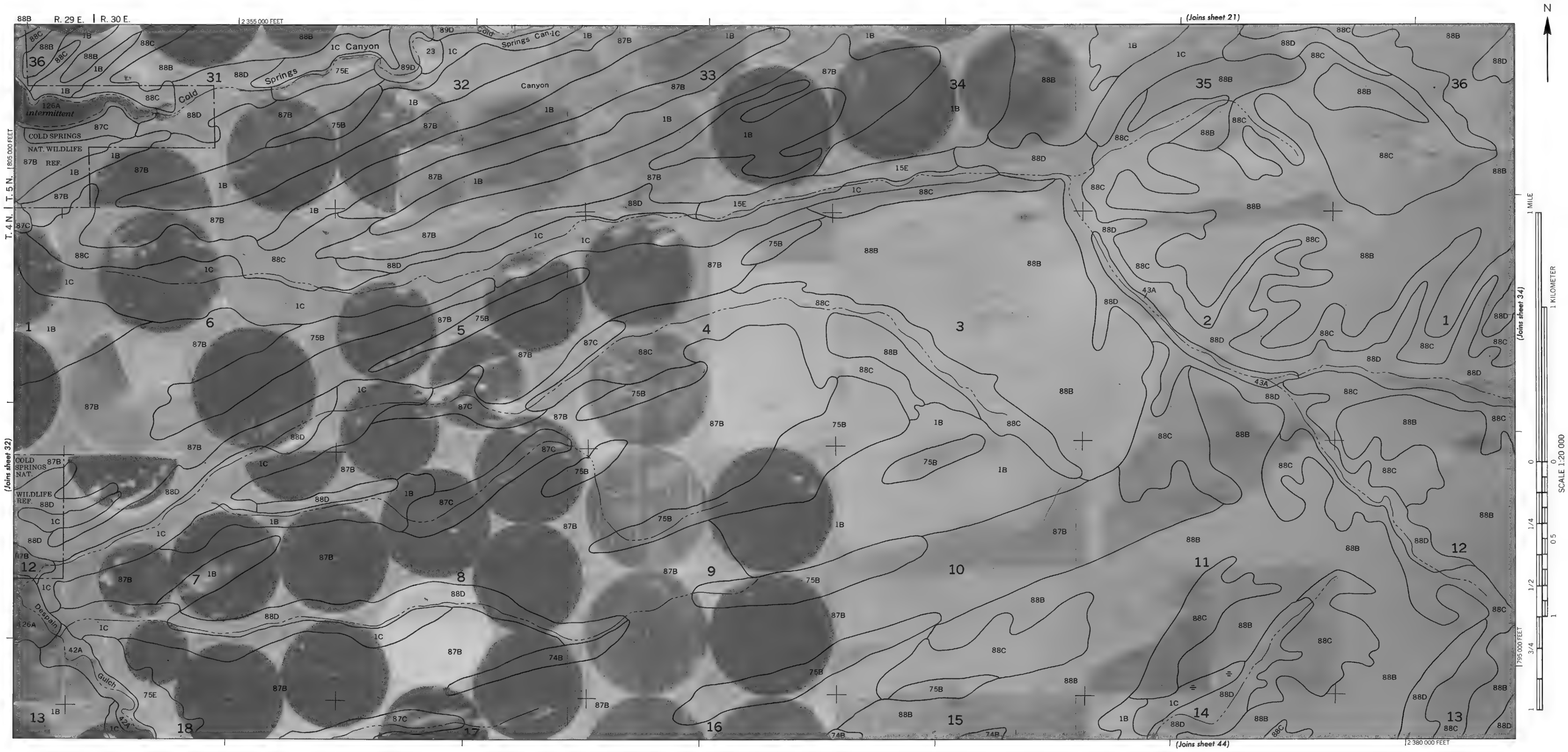

N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1

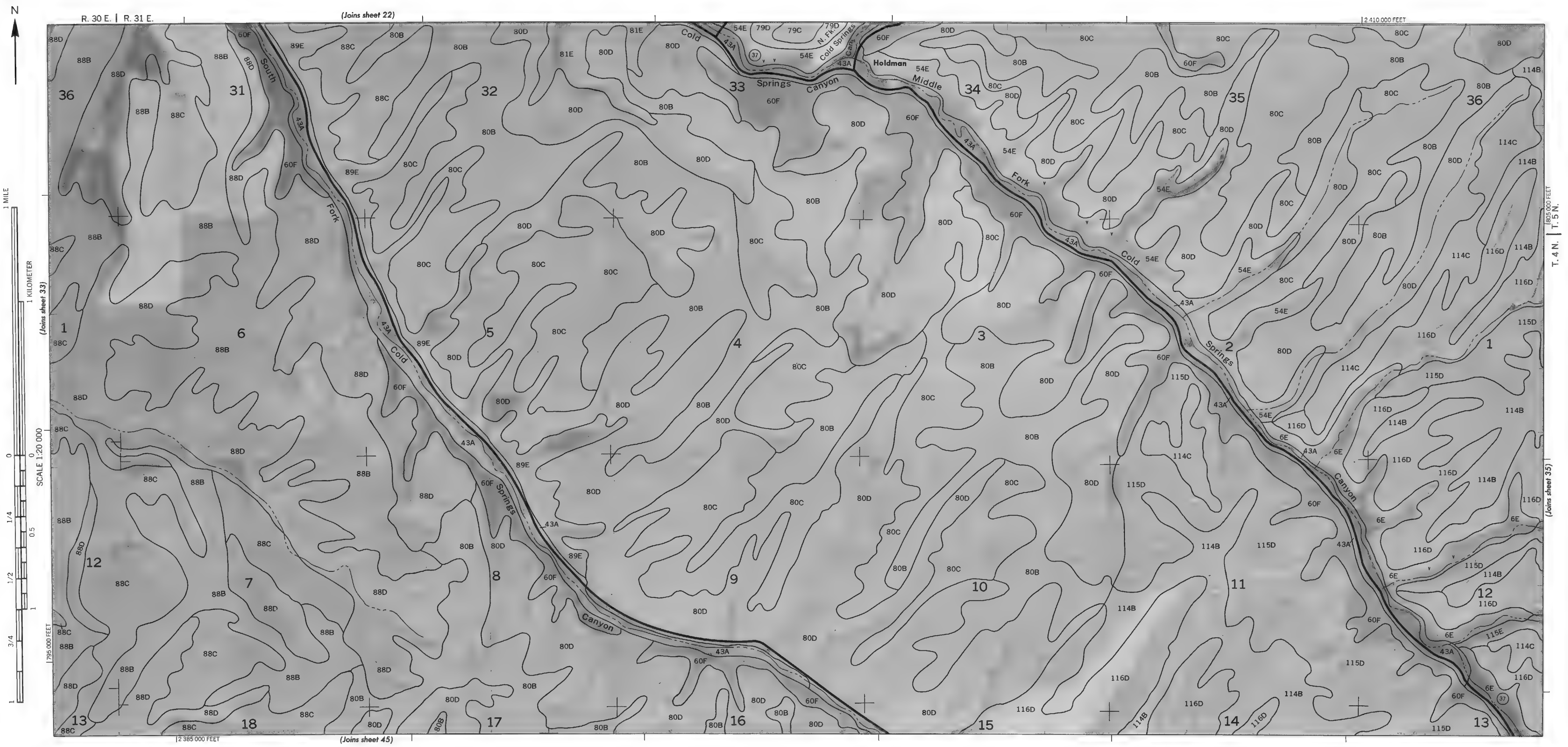

2 285 000 FEET
COLUMBIA RIVER
LAKE WALLULA
122B
15
119A
122B
14
14B
13
119A
75B
75B
75E
UNION PACIFIC
730
820 000 FEET
CANAL
IRRIGATION
EXTENSION
WEST
75E
119A
119A
75E
75E
75B
76B
22
75B
23
24
74B
75B
75B
T. 5 N.
MORROW COUNTY
75B
75E
(Joins sheet 19)
27
74B
26
75B
25
810 000 FEET
75B
74B
76B
Coyote Coulee
127F
14B
34
35
36
2 275 000 FEET
(Joins upper right)
R. 27 E.

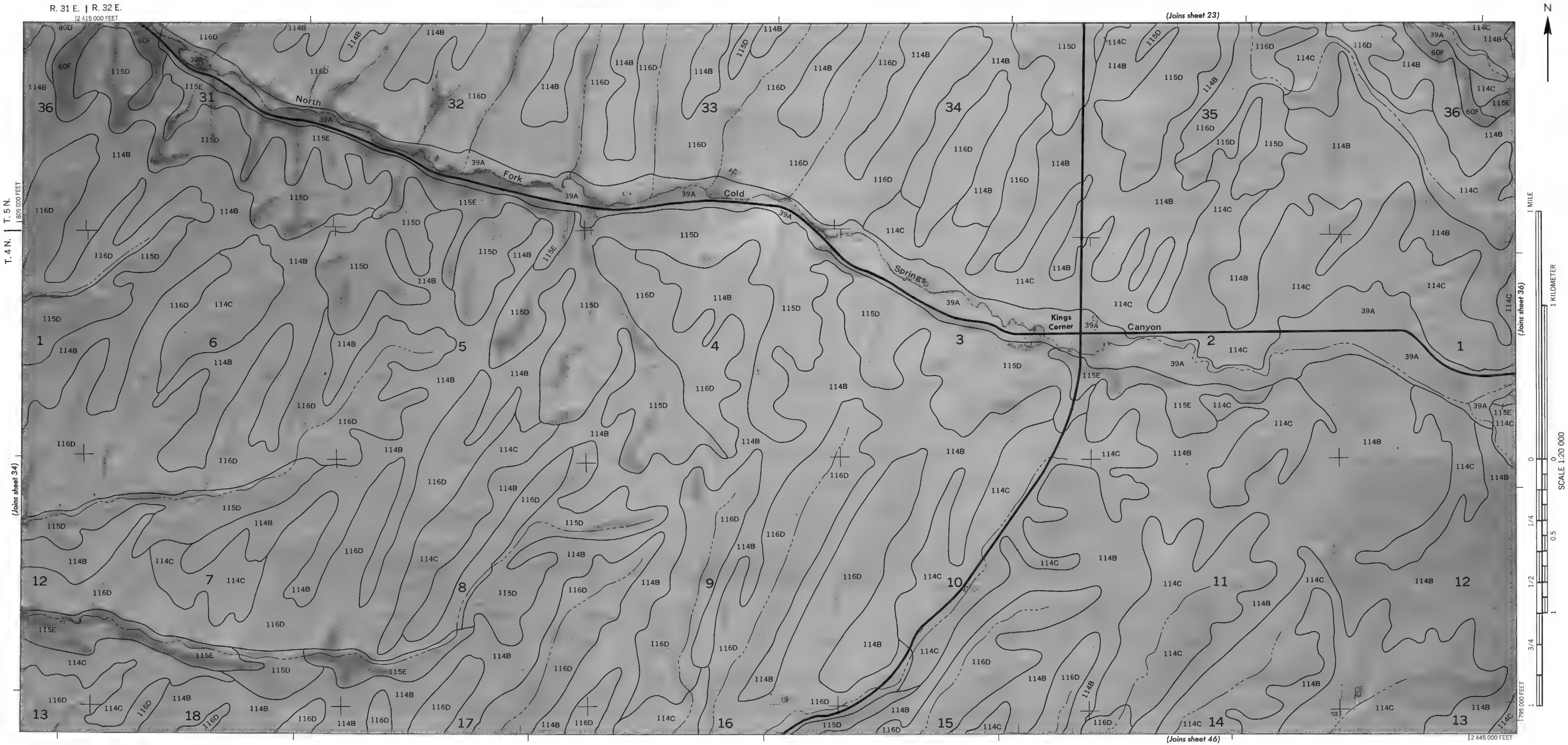

(Joins inset)
R. 27 E.
2 285 000 FEET
75B
75B
76B
74B
74B
127F
34
35
36
74B
74B
76B
14B
805 000 FEET
76B
14B
14B
74B
76B
127F
74B
T. 5 N.
T. 4 N.
76B
74B
74B
14B
3
2
1
14B
14B
74B
74B
Coulee
74B
74B
MORROW COUNTY
UMATILLA
127F
ORDNANCE
DEPOT
14B
74B
Coyote
14B
70
14B
(Joins sheet 31)
795 000 FEET
10
11
74B
12
127F
74B
14B
14B
14B
14B
15
14
13
2 275 000 FEET
(Joins sheet 41)

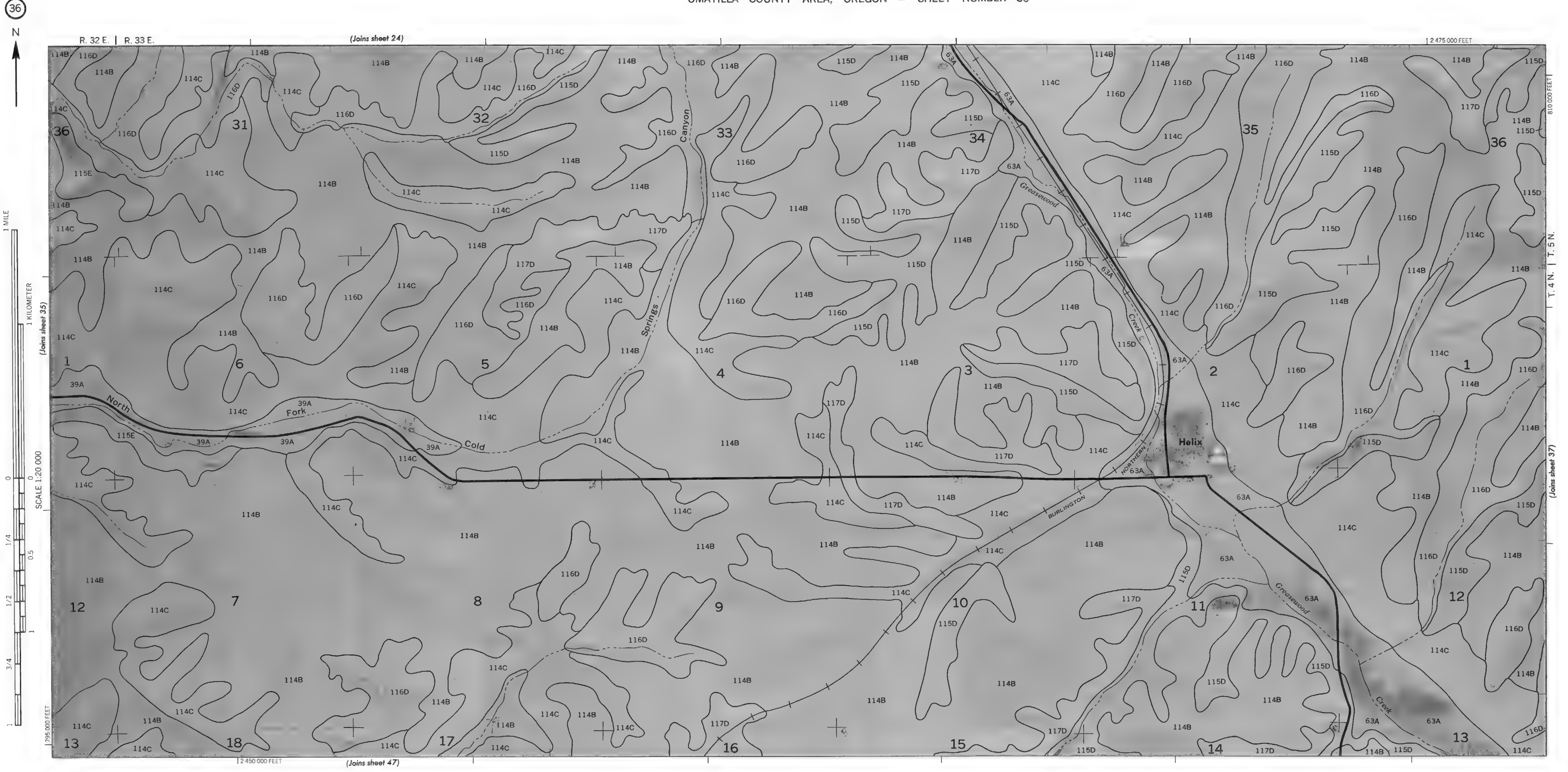

31
N
R. 27 E. | R. 28 E.
2 290 000 FEET
(Joins sheet 19)
805 000 FEET
T. 5 N.
T. 4 N.
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 42)
2 315 000 FEET
795 000 FEET
UMATILLA
RIVER
UNION PACIFIC
Hermiston Butte
HERMISTON
MAXWELL CANAL
LINE CANAL
UNION PACIFIC
FEED CANAL
water
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1

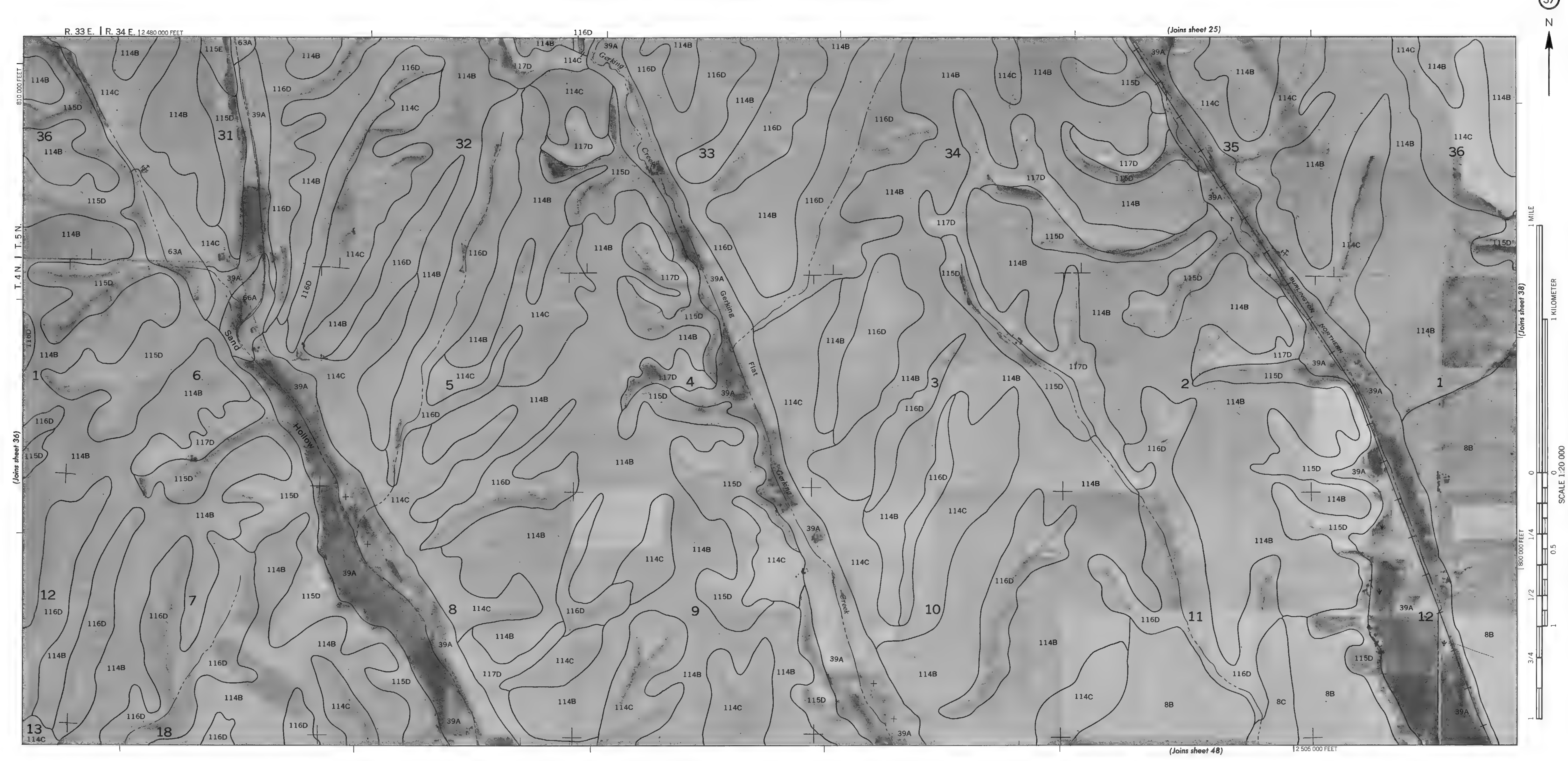

N
R. 28 E. | R. 29 E.
(Joins sheet 20)
(Joins sheet 31)
(Joins sheet 33)
(Joins sheet 43)
2 350 000 FEET
2 320 000 FEET
805 000 FEET
795 000 FEET
T. 5 N.
T. 4 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
COLD SPRINGS RESERVOIR
COLD SPRINGS NAT. WILDLIFE REF
Cold Springs
Cold Springs Canyon
Cold Springs Wash
Despain Gulch
intermittent
UNION PACIFIC
MAXWELL CANAL
FEED CANAL
water
207
1B
1C
2B
2C
3A
3C
70
74B
75B
75E
87B
87C
88B
88C
88D
89C
93B
95B
119A
122B
126A

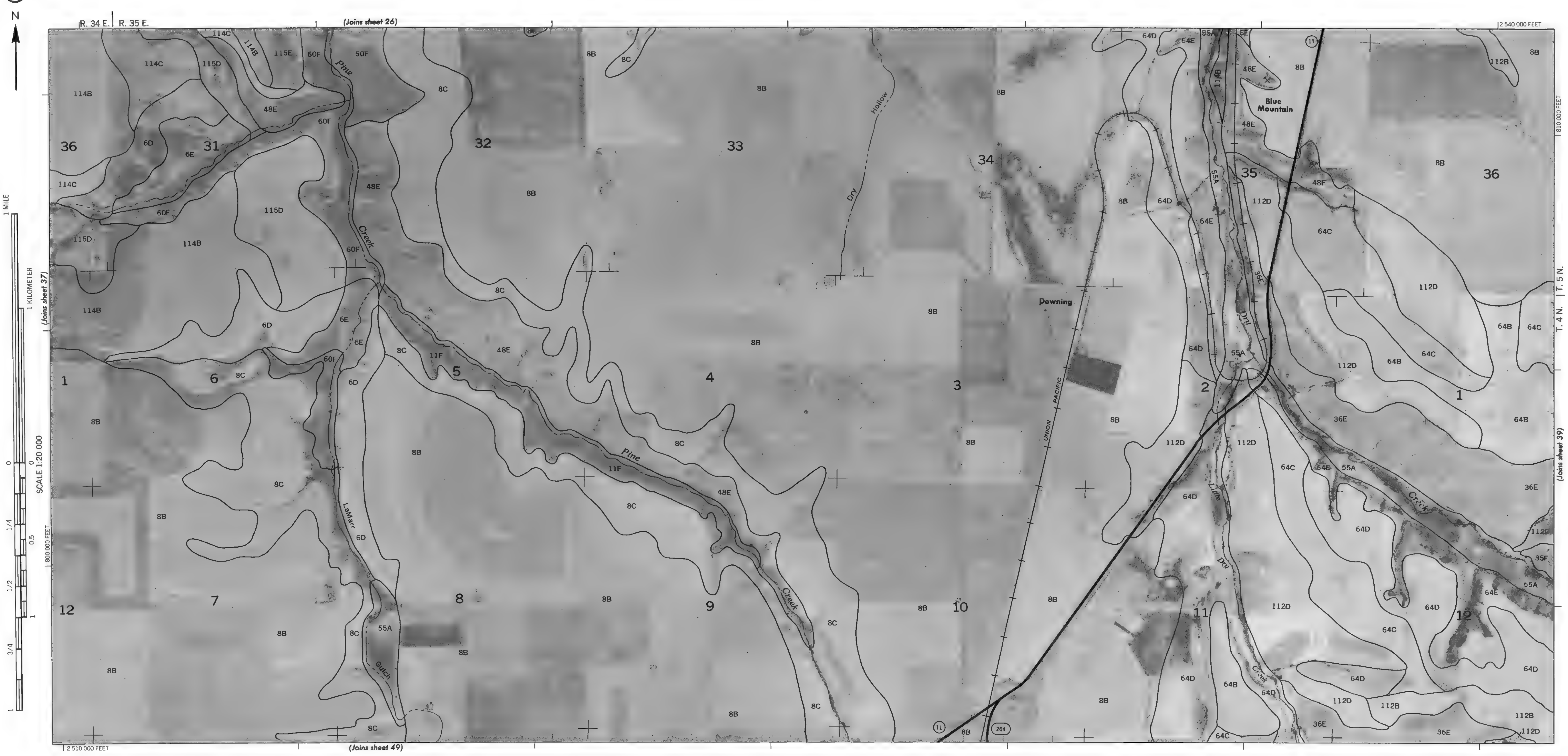

N
R. 29 E.
R. 30 E.
T. 5 N.
T. 4 N.
2 355 000 FEET
2 380 000 FEET
805 000 FEET
795 000 FEET
(Joins sheet 21)
(Joins sheet 44)
(Joins sheet 32)
(Joins sheet 34)
Cold Springs Canyon
COLD SPRINGS NAT. WILDLIFE REF.
intermittent
Despain Gulch
1 MILE
1 KILOMETER
SCALE 1:20 000

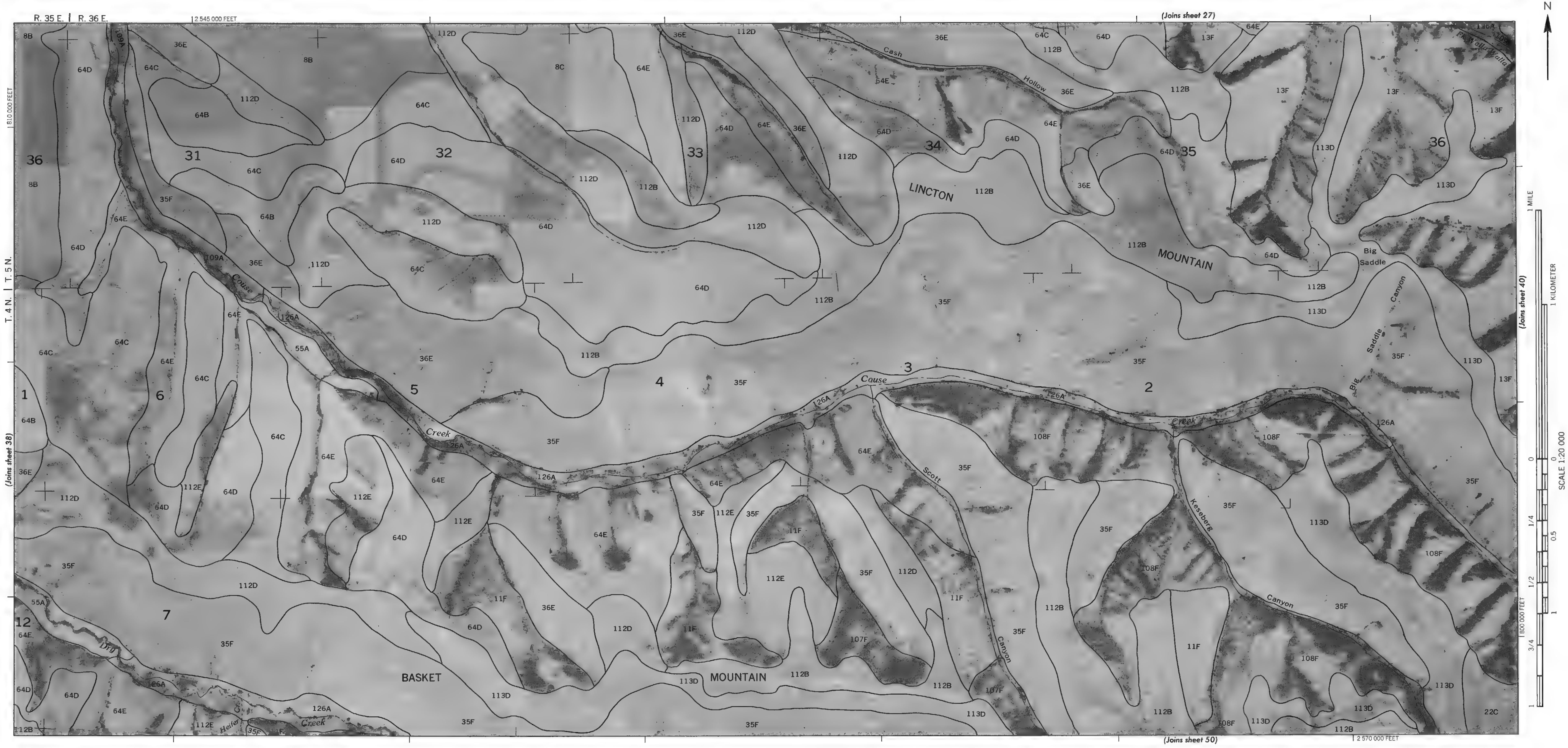

34
N
R. 30 E. | R. 31 E.
(Joins sheet 22)
2 410 000 FEET
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 45)
805 000 FEET
795 000 FEET
2 385 000 FEET
T. 4 N. | T. 5 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
0.5
1/2
3/4
1
Holdman
South Fork Cold Springs Canyon
Middle Fork Cold Springs Canyon
N. Fk. Cold Springs Can.
Cold Springs Canyon
37
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
13
18
17
16
15
14
13

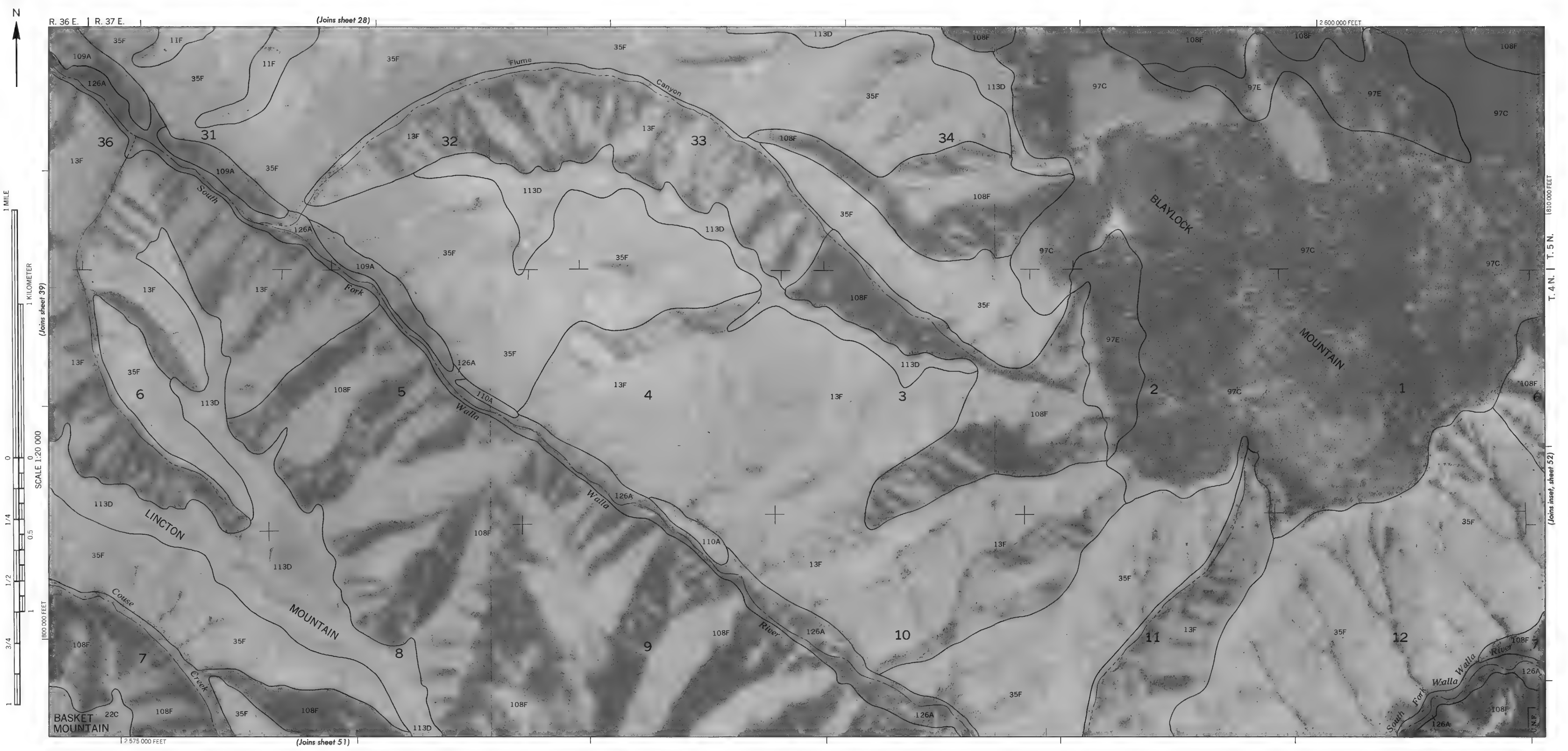

R. 31 E. | R. 32 E.
2 415 000 FEET
T. 5 N.
T. 4 N.
805 000 FEET
795 000 FEET
2 445 000 FEET
(Joins sheet 23)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 46)
N
North Fork Cold Springs Canyon
Kings Corner
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5

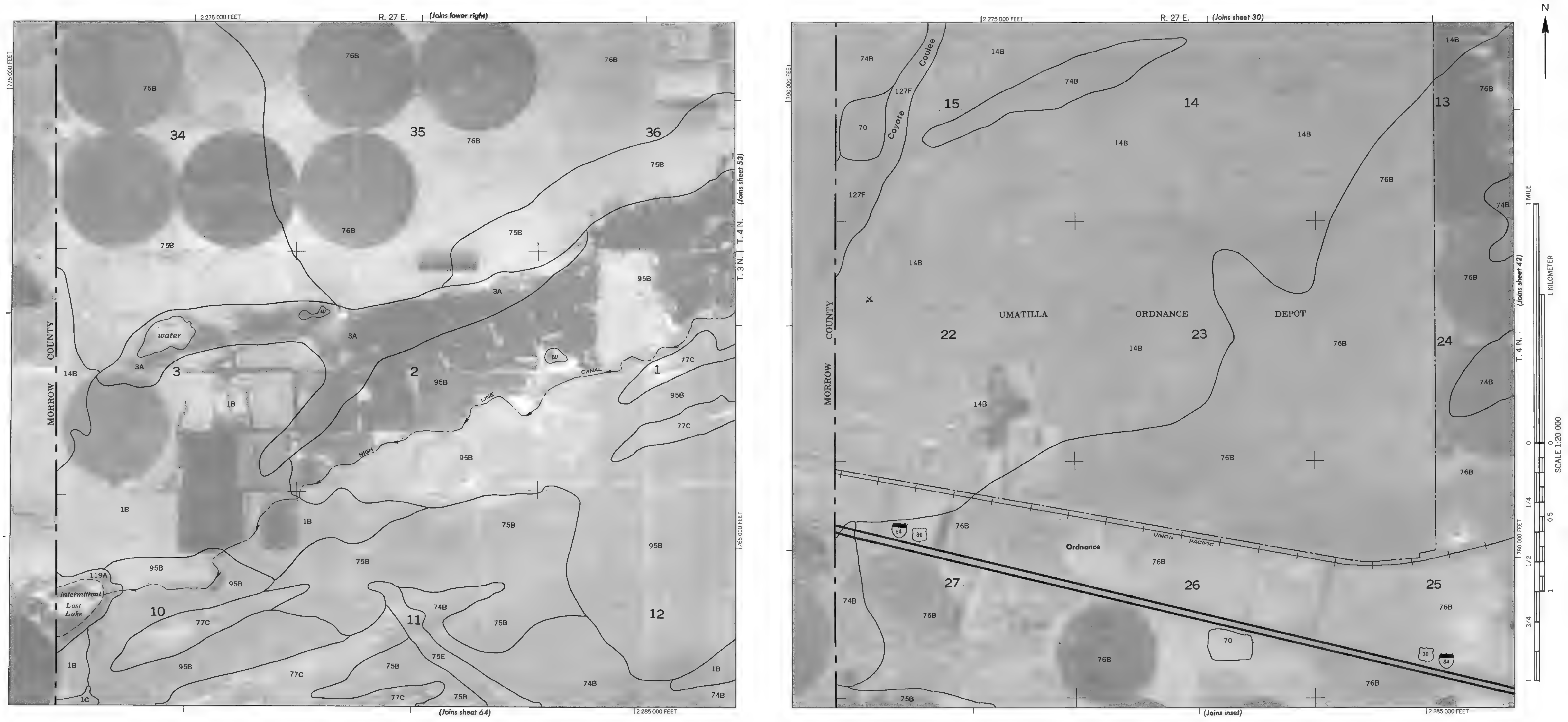

36
N
R. 32 E. | R. 33 E.
(Joins sheet 24)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 47)
2 475 000 FEET
2 450 000 FEET
810 000 FEET
795 000 FEET
T. 5 N.
T. 4 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
Helix
North Fork Cold
Canyon Springs
Greasewood Creek
NORTHERN
BURLINGTON
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
13
18
17
16
15
14
13


37
N
R. 33 E. | R. 34 E.
2 480 000 FEET
(Joins sheet 25)
810 000 FEET
T. 5 N. | T. 4 N.
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 48)
2 505 000 FEET
800 000 FEET
Sand Hollow
Gerking Creek
Gerking Flat
Gerking Creek
BURLINGTON NORTHERN
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
13
18
114B
114C
115D
115E
116D
117D
39A
63A
66A
8B
8C
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1

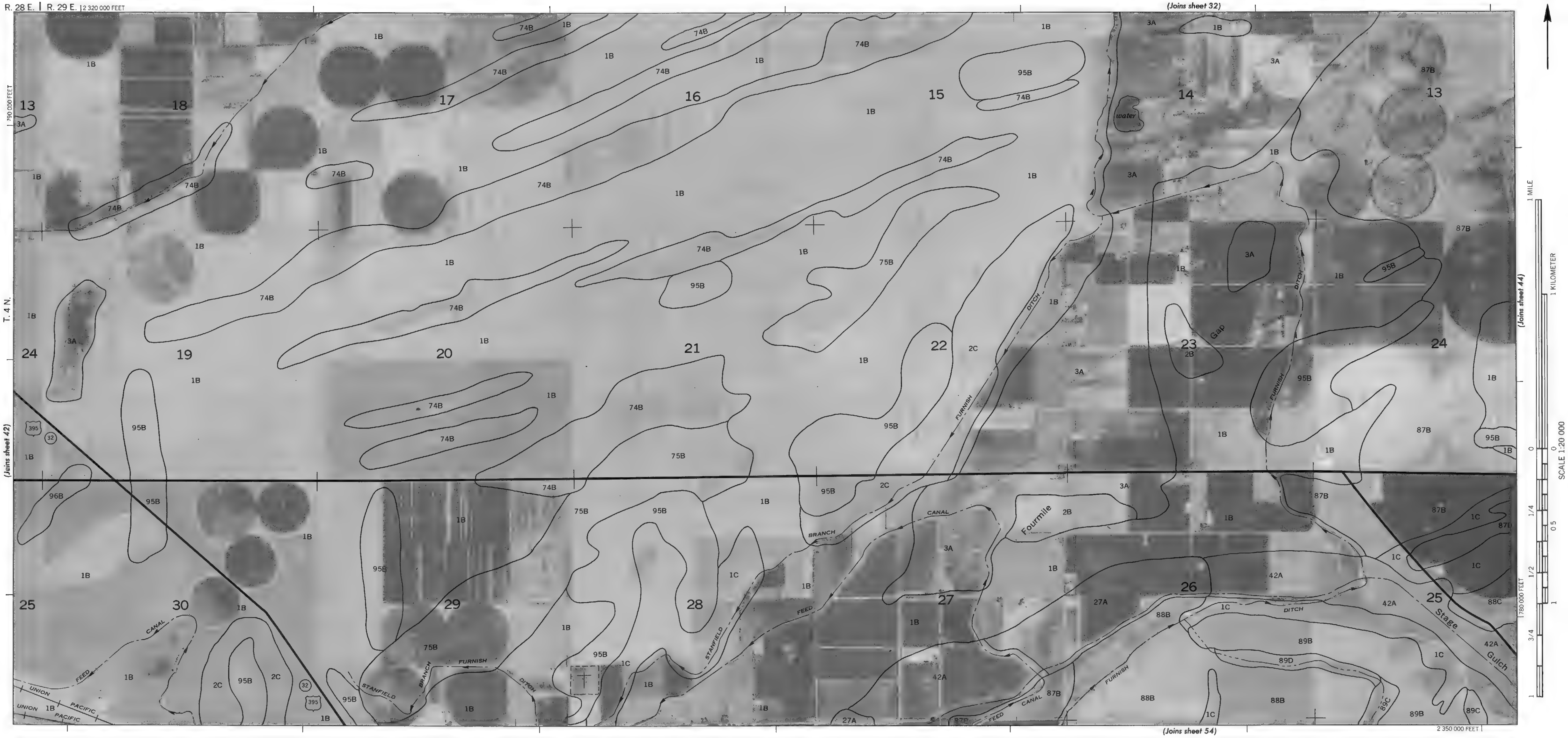

N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
R. 34 E.
R. 35 E.
(Joins sheet 26)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 49)
2 540 000 FEET
810 000 FEET
800 000 FEET
2 510 000 FEET
T. 5 N.
T. 4 N.
Pine Creek
Dry Hollow
LaMarr Gulch
Little Dry Creek
Dry Creek
Downing
Blue Mountain
UNION PACIFIC
11
204
36
31
32
33
34
35
1
6
5
4
3
2
12
7
8
9
10
11
114C
114B
115E
115D
60F
50F
48E
6D
6E
8B
8C
11F
6D
55A
64D
64E
64C
64B
112D
112B
36E
35F


39
N
R. 35 E. | R. 36 E.
2 545 000 FEET
(Joins sheet 27)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 50)
2 570 000 FEET
810 000 FEET
800 000 FEET
T. 5 N.
T. 4 N.
LINCTON
MOUNTAIN
BASKET
MOUNTAIN
Cash
Hollow
Couse
Creek
Scott
Canyon
Keseberg
Canyon
Big
Saddle
Big Saddle Canyon
Dry
Heifer
1 MILE
1 KILOMETER
SCALE 1:20 000

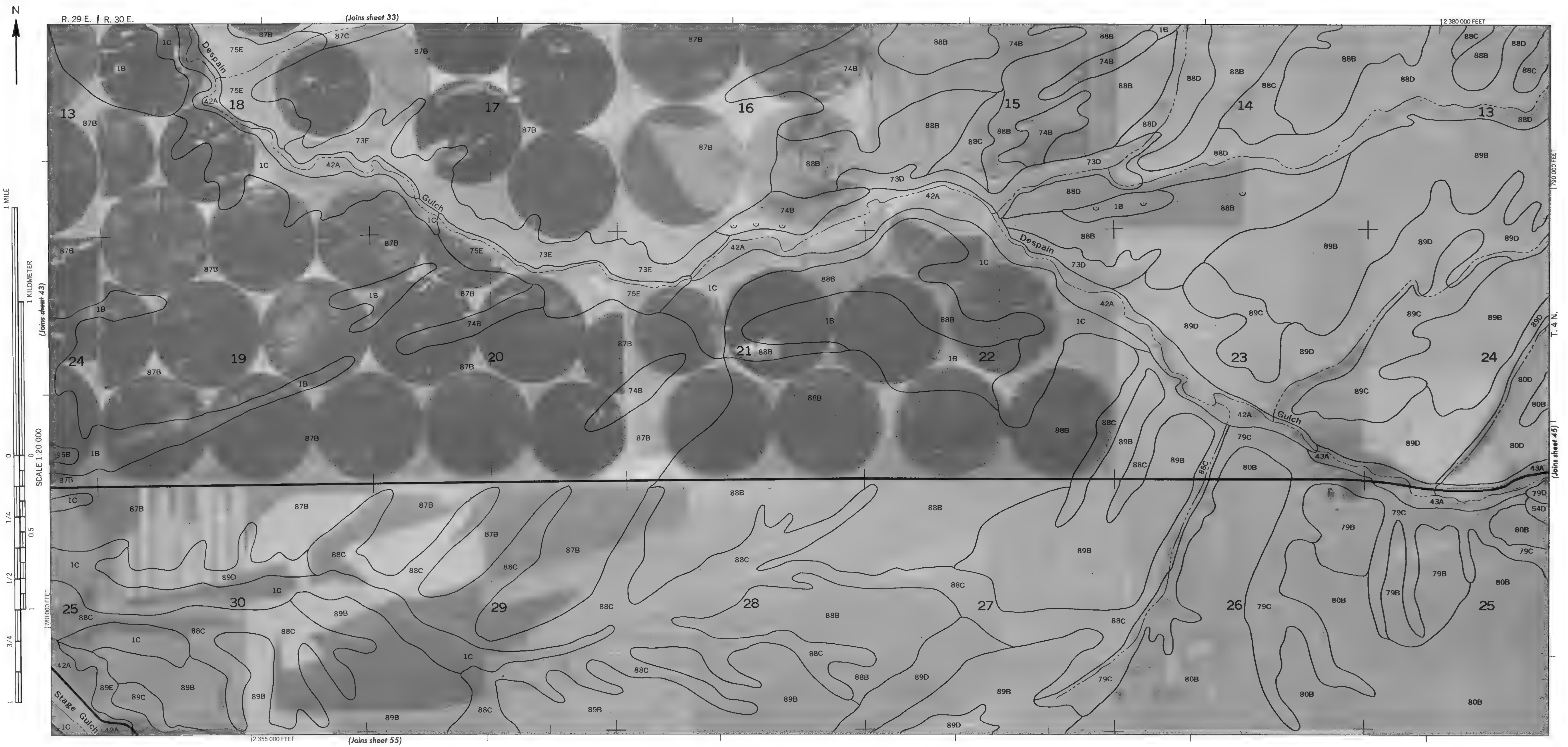

N
R. 36 E. | R. 37 E.
(Joins sheet 28)
(Joins sheet 39)
(Joins inset, sheet 52)
(Joins sheet 51)
2 600 000 FEET
2 575 000 FEET
810 000 FEET
800 000 FEET
T. 5 N. | T. 4 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
Flume Canyon
South Fork Walla Walla River
Couse Creek
BLAYLOCK MOUNTAIN
LINCTON MOUNTAIN
BASKET MOUNTAIN
36
31
32
33
34
6
5
4
3
2
1
7
8
9
10
11
12
35F
11F
109A
126A
13F
113D
108F
97C
97E
110A
22C
U.N.F.

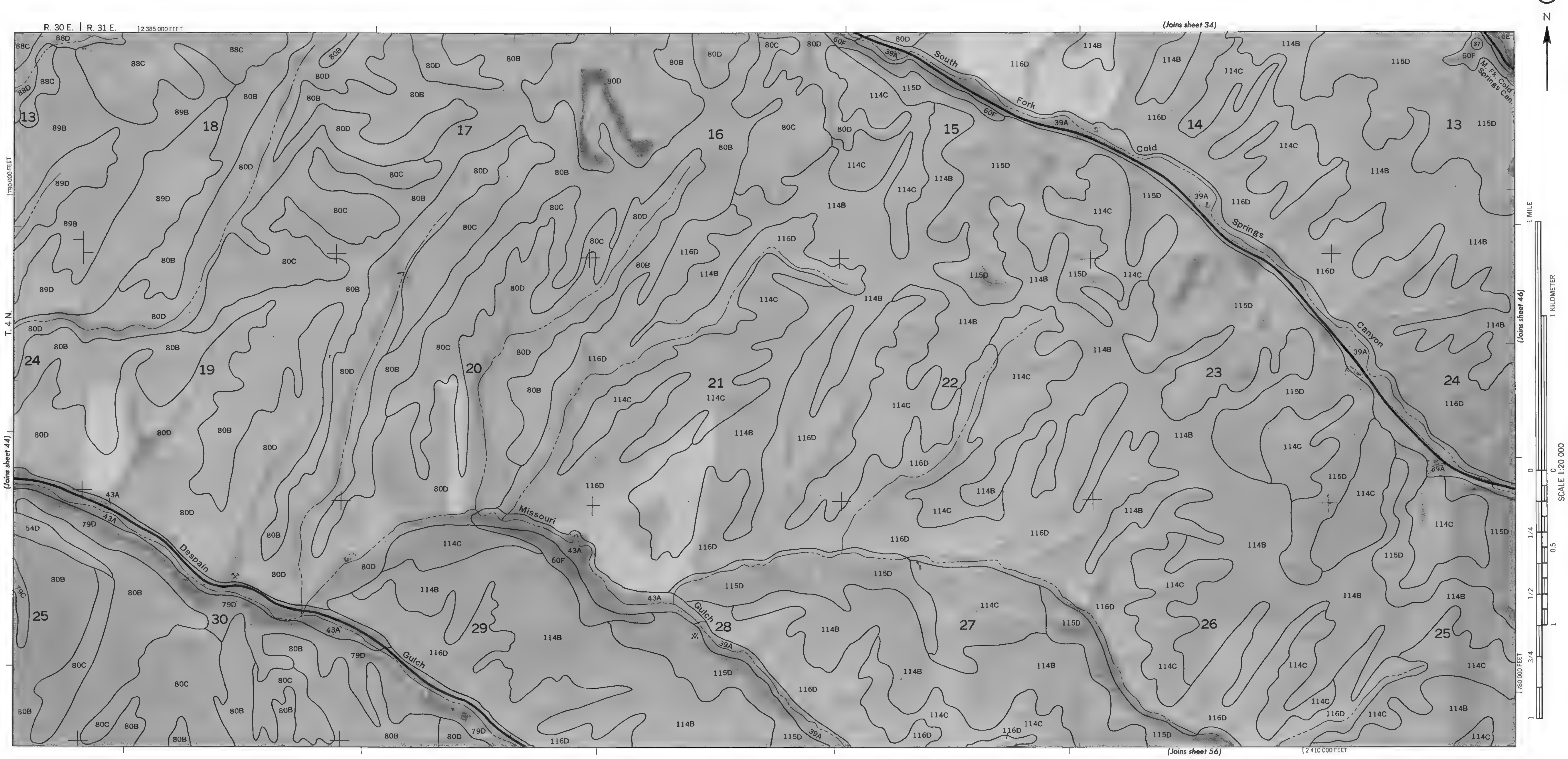

41
N
R. 27 E.
(Joins lower right)
(Joins sheet 30)
(Joins sheet 53)
(Joins sheet 42)
(Joins sheet 64)
(Joins inset)
T. 4 N.
T. 3 N.
MORROW COUNTY
UMATILLA ORDNANCE DEPOT
Coyote Coulee
HIGH LINE CANAL
UNION PACIFIC
Ordnance
water
intermittent
Lost Lake
2 275 000 FEET
2 285 000 FEET
775 000 FEET
765 000 FEET
790 000 FEET
780 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000

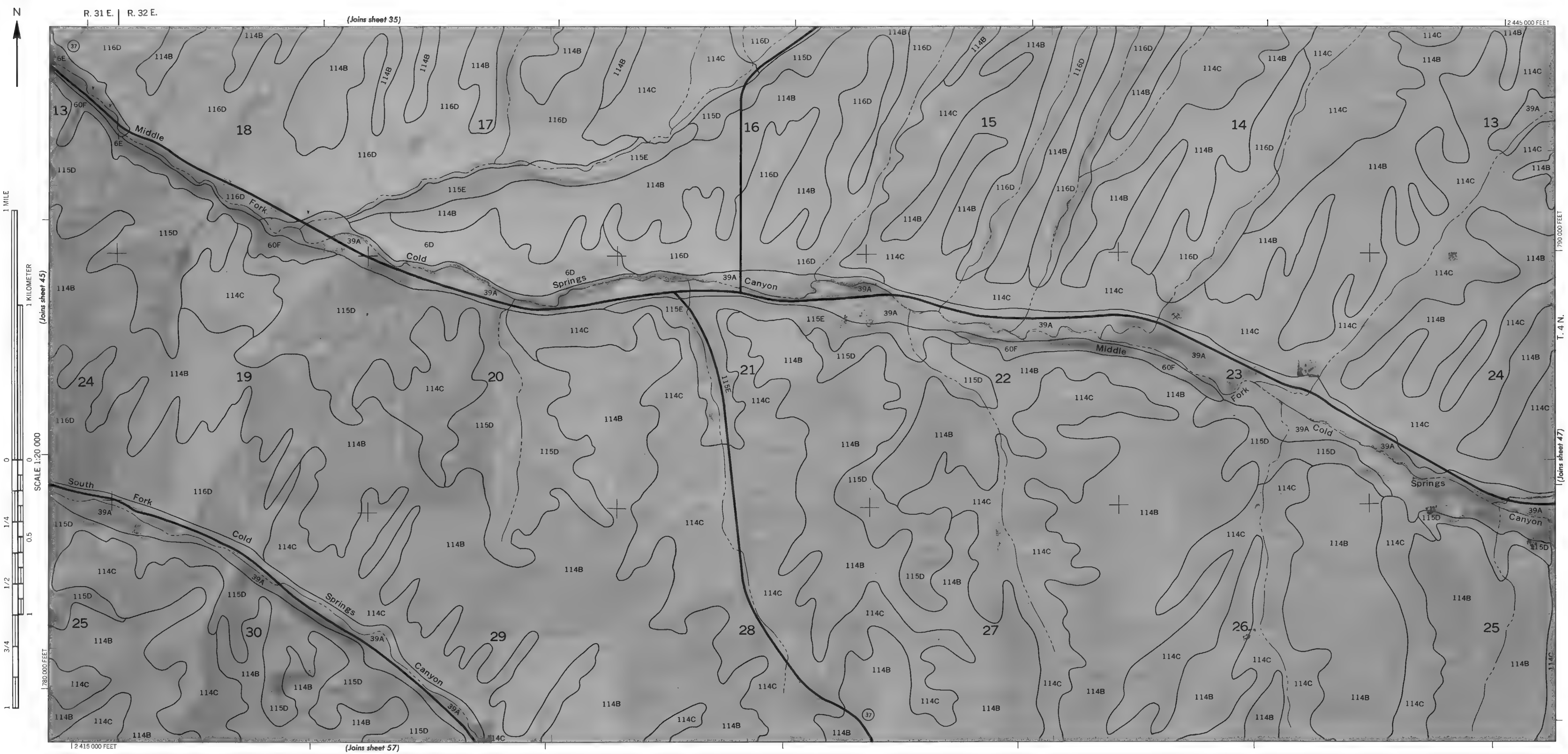

N
R. 27 E.
R. 28 E.
(Joins sheet 31)
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 53)
T. 4 N.
2 315 000 FEET
790 000 FEET
780 000 FEET
2 290 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
HERMISTON
Hermiston Airport
Westland
Hinkle
Cottonwood Bend
UMATILLA RIVER
Umatilla River
Butter Creek
UNION PACIFIC
MAXWELL CANAL
CANAL LINE
FEED CANAL
13
18
17
16
15
14
13
24
19
20
21
22
23
24
25
30
29
28
27
26
25
76B
74B
75E
126A
3A
2B
4B
14B
75B
47B
70
95B
2C
1B
85F
72A
42A
27A
1C

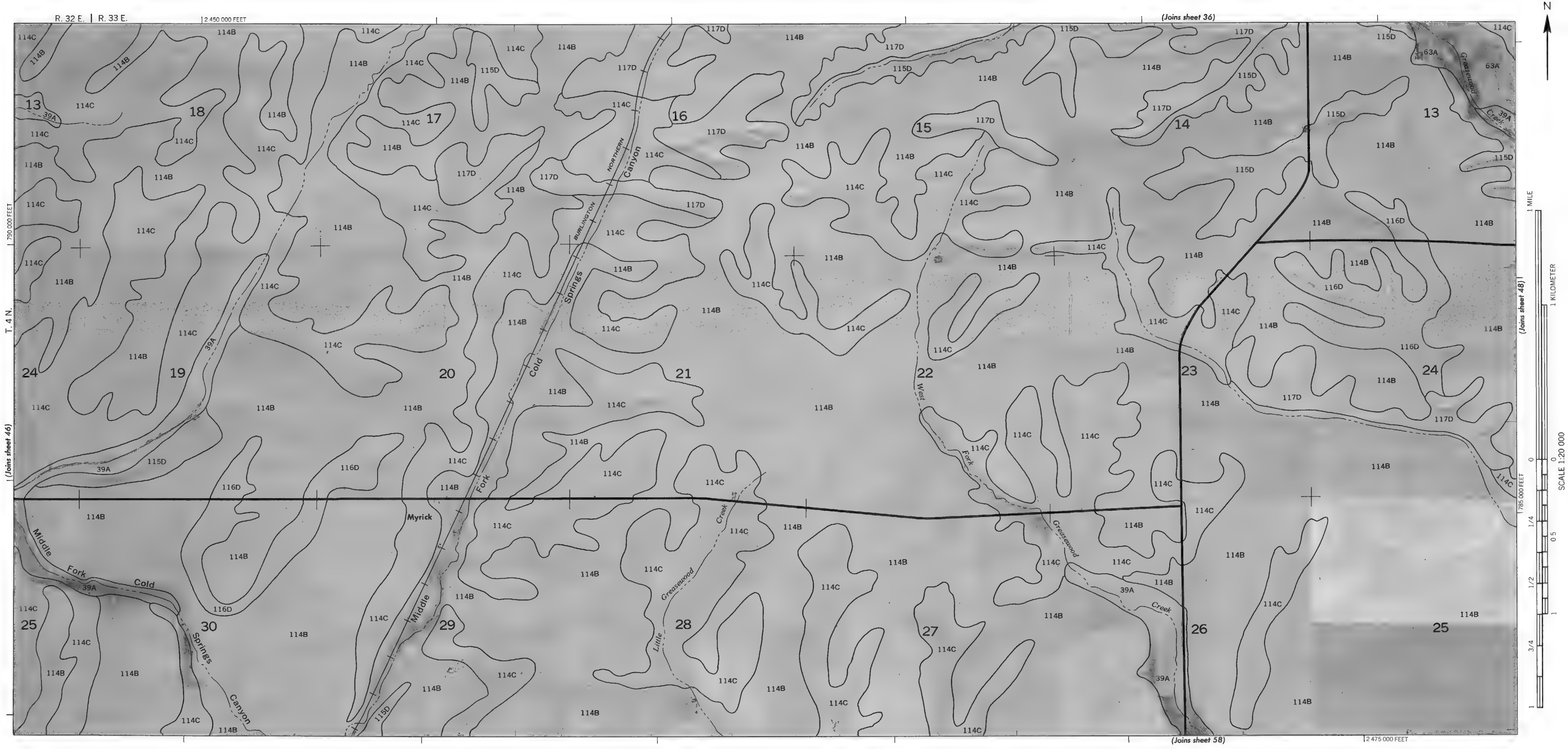


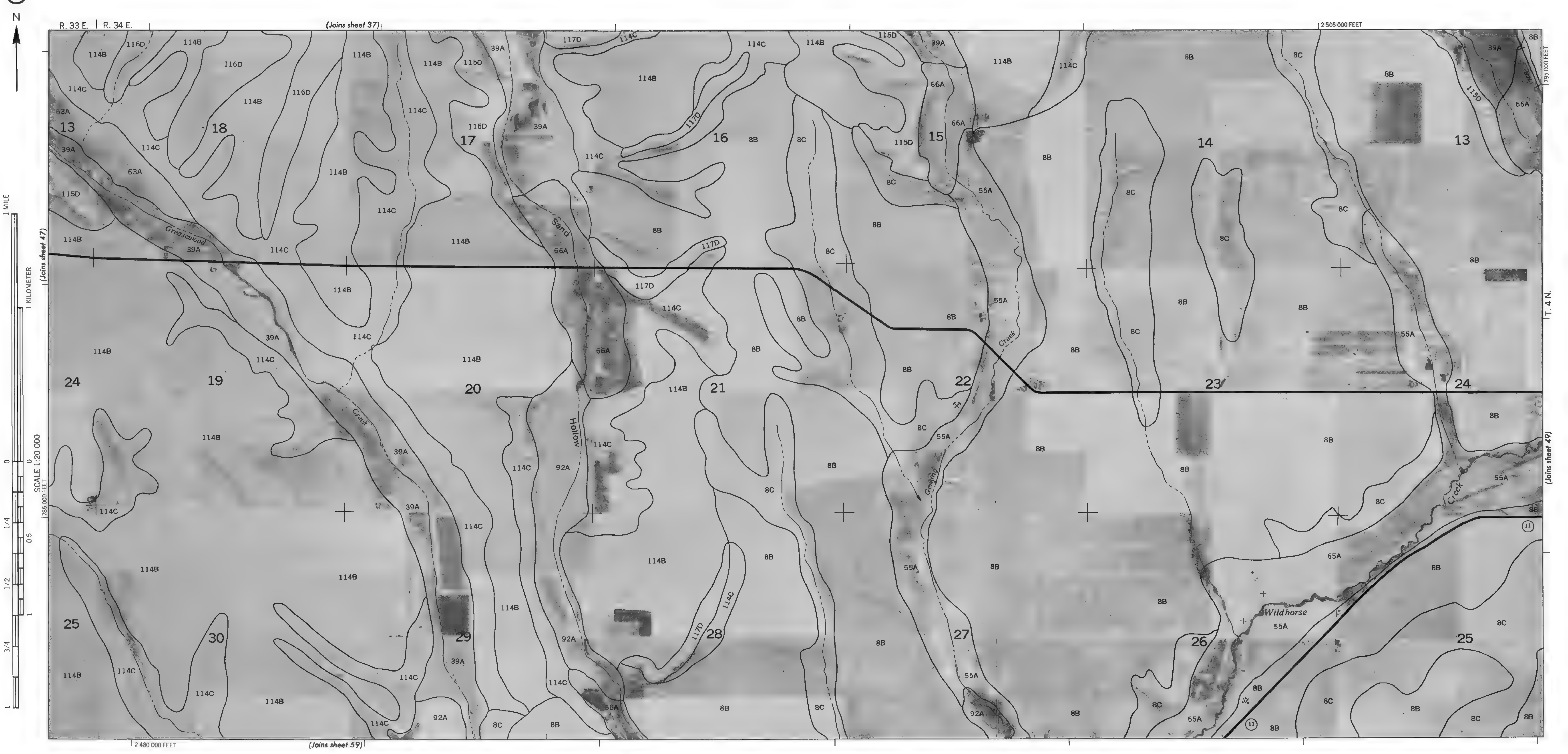
R. 28 E.
R. 29 E.
2 320 000 FEET
(Joins sheet 32)
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 54)
2 350 000 FEET
780 000 FEET
T. 4 N.
N
1 MILE
1 KILOMETER
SCALE 1:20 000
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
water
Gap
Fourmile
Stage
Gulch
FURNISH
DITCH
STANFIELD
BRANCH
FEED
CANAL
UNION
PACIFIC
395
32
1B
1C
2B
2C
3A
27A
42A
74B
75B
87B
87D
88B
88C
89B
89C
89D
95B
96B


N
R. 29 E. | R. 30 E.
(Joins sheet 33)
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 55)
T. 4 N.
2 380 000 FEET
790 000 FEET
780 000 FEET
2 355 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
Despain Gulch
Stage Gulch
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
1B
1C
42A
43A
54D
73D
73E
74B
75E
79B
79C
79D
80B
80D
87B
87C
88B
88C
88D
89B
89C
89D
89E
95B

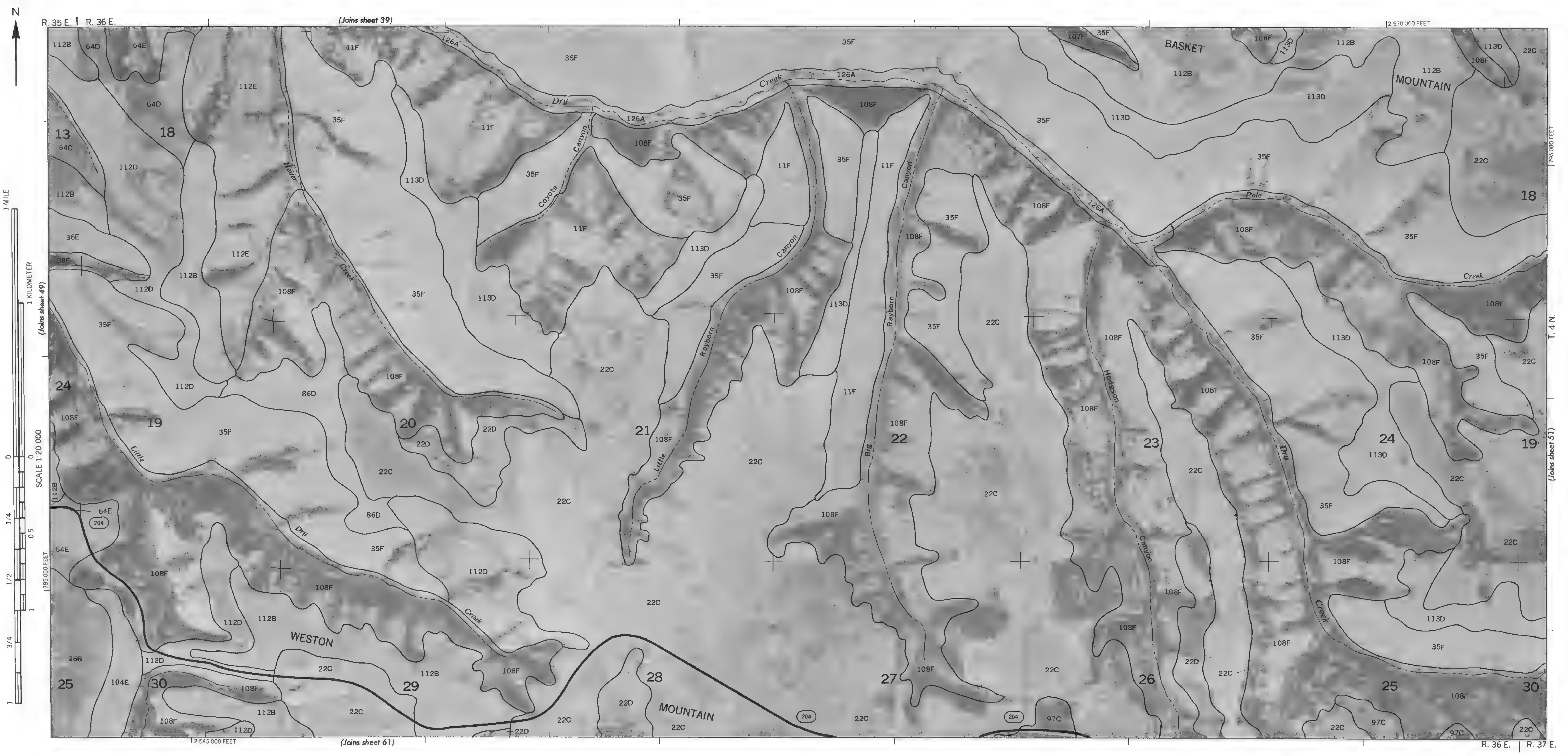

45
N
R. 30 E. | R. 31 E.
2 385 000 FEET
(Joins sheet 34)
(Joins sheet 46)
(Joins sheet 44)
(Joins sheet 56)
2 410 000 FEET
790 000 FEET
780 000 FEET
T. 4 N.
South Fork Cold Springs Canyon
M. Fk. Cold Springs Can.
Missouri Gulch
Despain Gulch
1 MILE
1 KILOMETER
SCALE 1:20 000

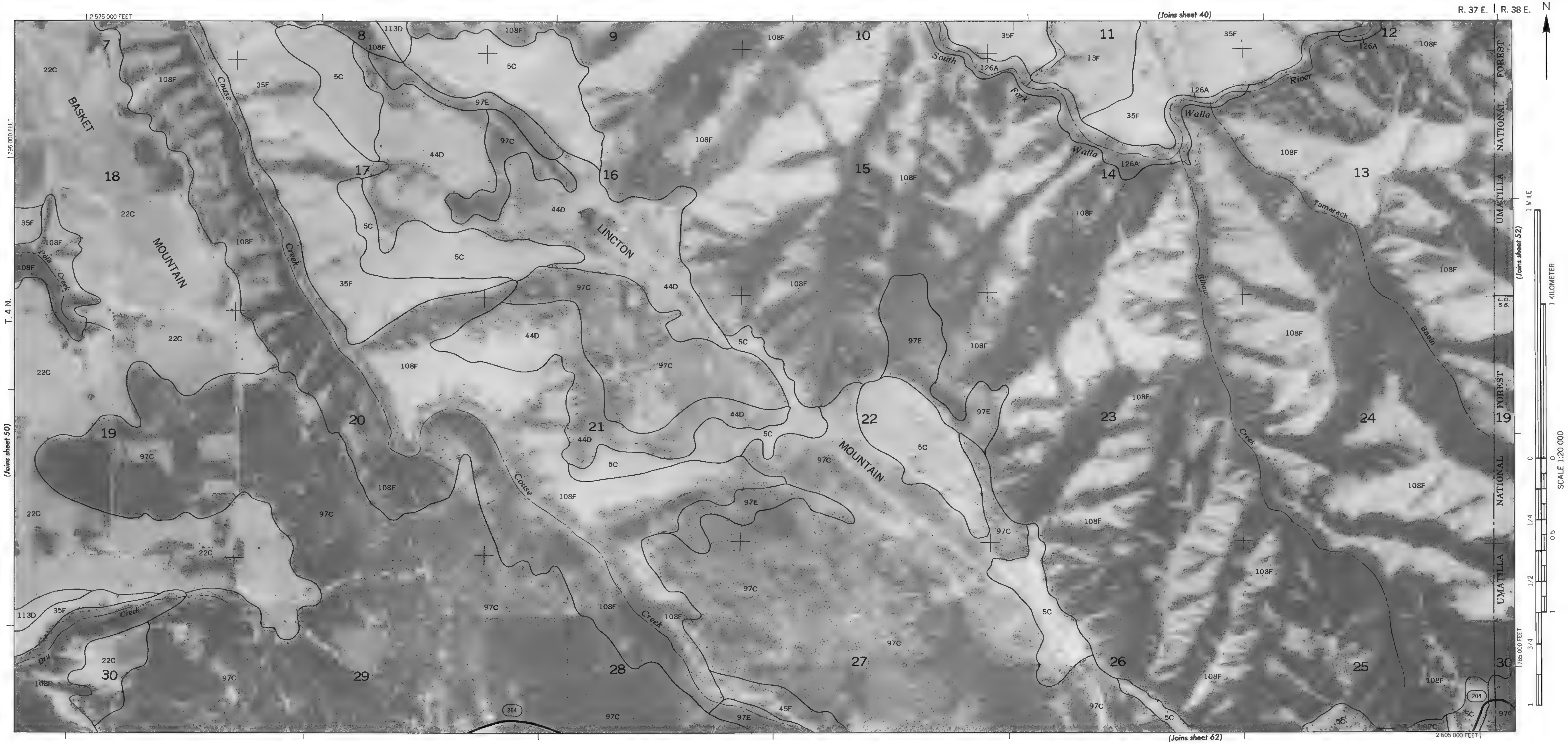

46
N
R. 31 E.
R. 32 E.
(Joins sheet 35)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 57)
T. 4 N.
2 445 000 FEET
2 415 000 FEET
790 000 FEET
780 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
Middle Fork Cold Springs Canyon
South Fork Cold Springs Canyon
37
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
6D
6E
39A
60F
114B
114C
115D
115E
116D


N
R. 32 E. | R. 33 E.
2 450 000 FEET
(Joins sheet 36)
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 58)
2 475 000 FEET
790 000 FEET
785 000 FEET
T. 4 N.
13
18
17
16
15
14
13
24
19
20
21
22
23
24
25
30
29
28
27
26
25
Myrick
NORTHERN
BURLINGTON
Cold Springs Canyon
Middle Fork Cold Springs Canyon
West Fork Greasewood
Greasewood Creek
Little Greasewood Creek
114B
114C
115D
116D
117D
39A
63A
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5

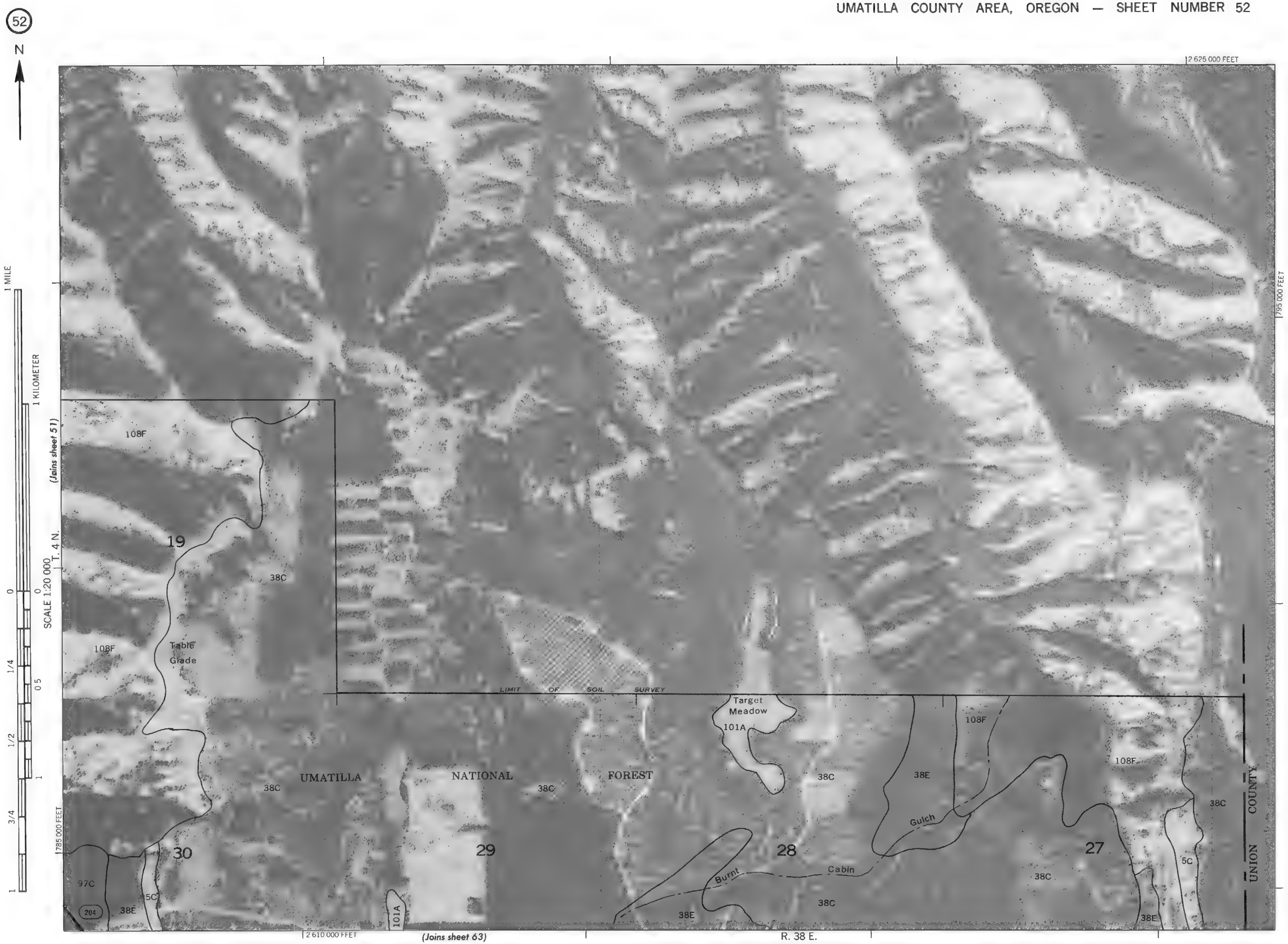

48
N
R. 33 E.
R. 34 E.
(Joins sheet 37)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 59)
2 505 000 FEET
2 480 000 FEET
795 000 FEET
785 000 FEET
T. 4 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
Greasewood
Creek
Sand
Hollow
Gerking
Creek
Wildhorse
Creek
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
11

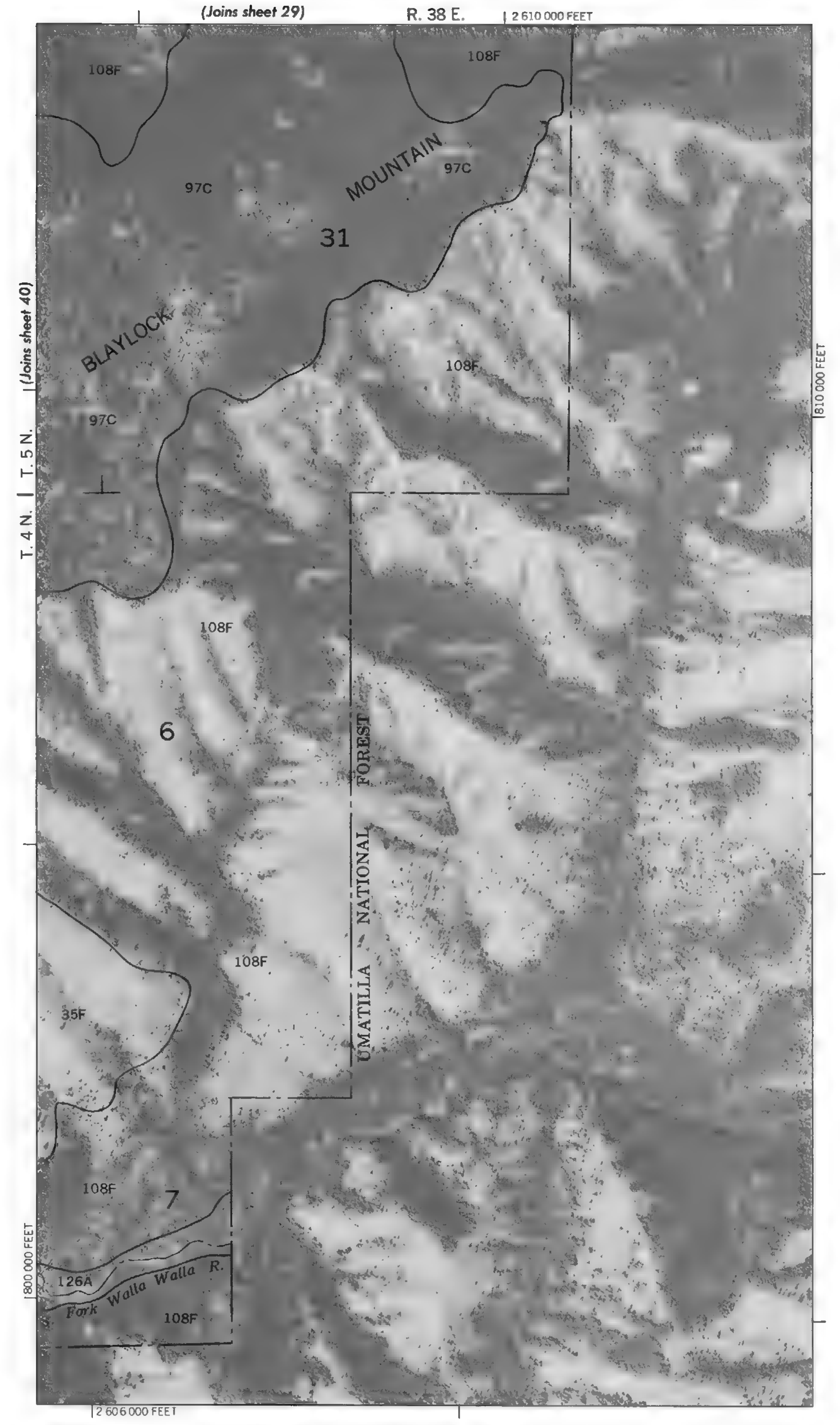

N
R. 34 E.
R. 35 E.
2 510 000 FEET
795 000 FEET
T. 4 N.
(Joins sheet 38)
(Joins sheet 48)
(Joins sheet 50)
(Joins sheet 60)
2 540 000 FEET
785 000 FEET
Athena
Weston
BURLINGTON NORTHERN
UNION PACIFIC
LaMarr Gulch
Wildhorse Creek
Pine Creek
Intermittent
Hay Creek
Little Dry Creek
WESTON MOUNTAIN
11
204
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
8B
8C
35F
36E
55A
64B
64C
64D
64E
66A
96B
96D
107E
107F
108F
112B
112D
112E
1 MILE
1 KILOMETER
SCALE 1:20 000


N
R. 35 E. | R. 36 E.
(Joins sheet 39)
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 61)
2 570 000 FEET
795 000 FEET
785 000 FEET
2 545 000 FEET
T. 4 N.
R. 36 E. | R. 37 E.
1 MILE
1 KILOMETER
SCALE 1:20 000
BASKET MOUNTAIN
WESTON MOUNTAIN
Dry Creek
Pole Creek
Coyote Canyon
Heiter Creek
Little Dry Creek
Little Rayborn Canyon
Big Rayborn Canyon
Hodgson Canyon
204



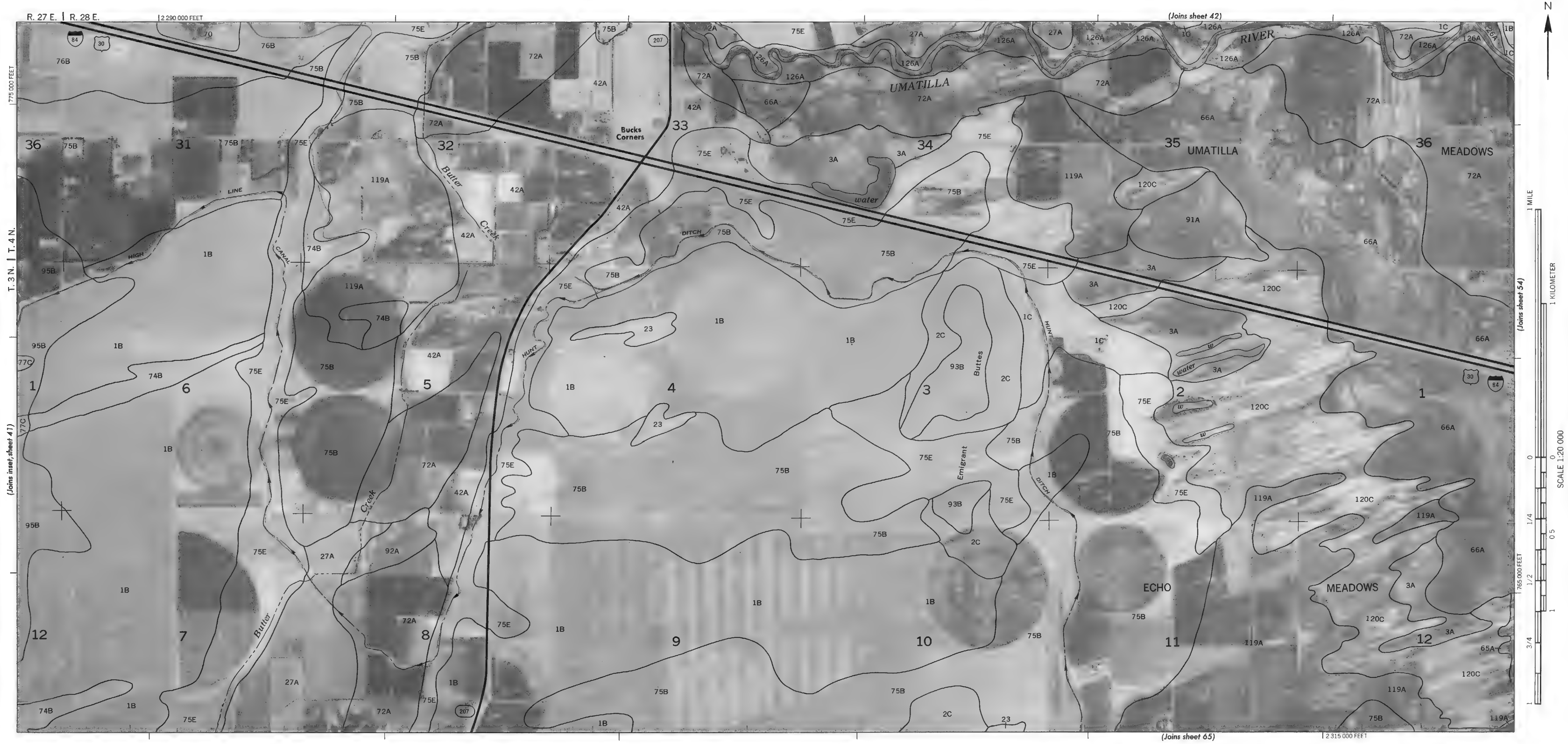
(Joins sheet 40)
(Joins sheet 50)
(Joins sheet 52)
(Joins sheet 62)
2 575 000 FEET
2 605 000 FEET
795 000 FEET
785 000 FEET
R. 37 E.
R. 38 E.
N
T. 4 N.
BASKET
MOUNTAIN
LINCTON
MOUNTAIN
Couse Creek
Pole Creek
Dry Creek
South Fork Walla Walla River
Elbow Creek
Tamarack Basin
UMATILLA NATIONAL FOREST
UMATILLA NATIONAL FOREST
L.O.
S.S.
204
1 MILE
1 KILOMETER
SCALE 1:20 000

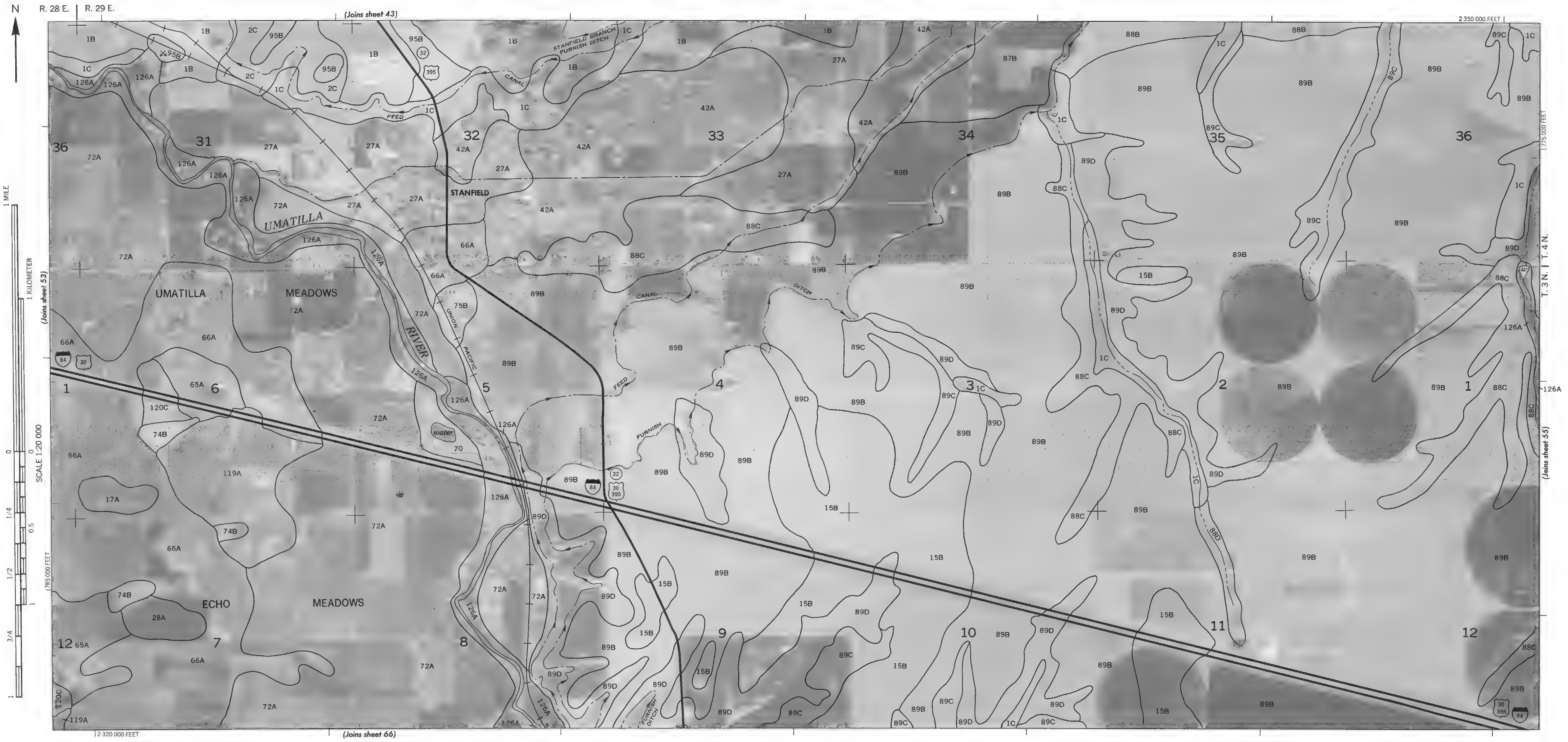


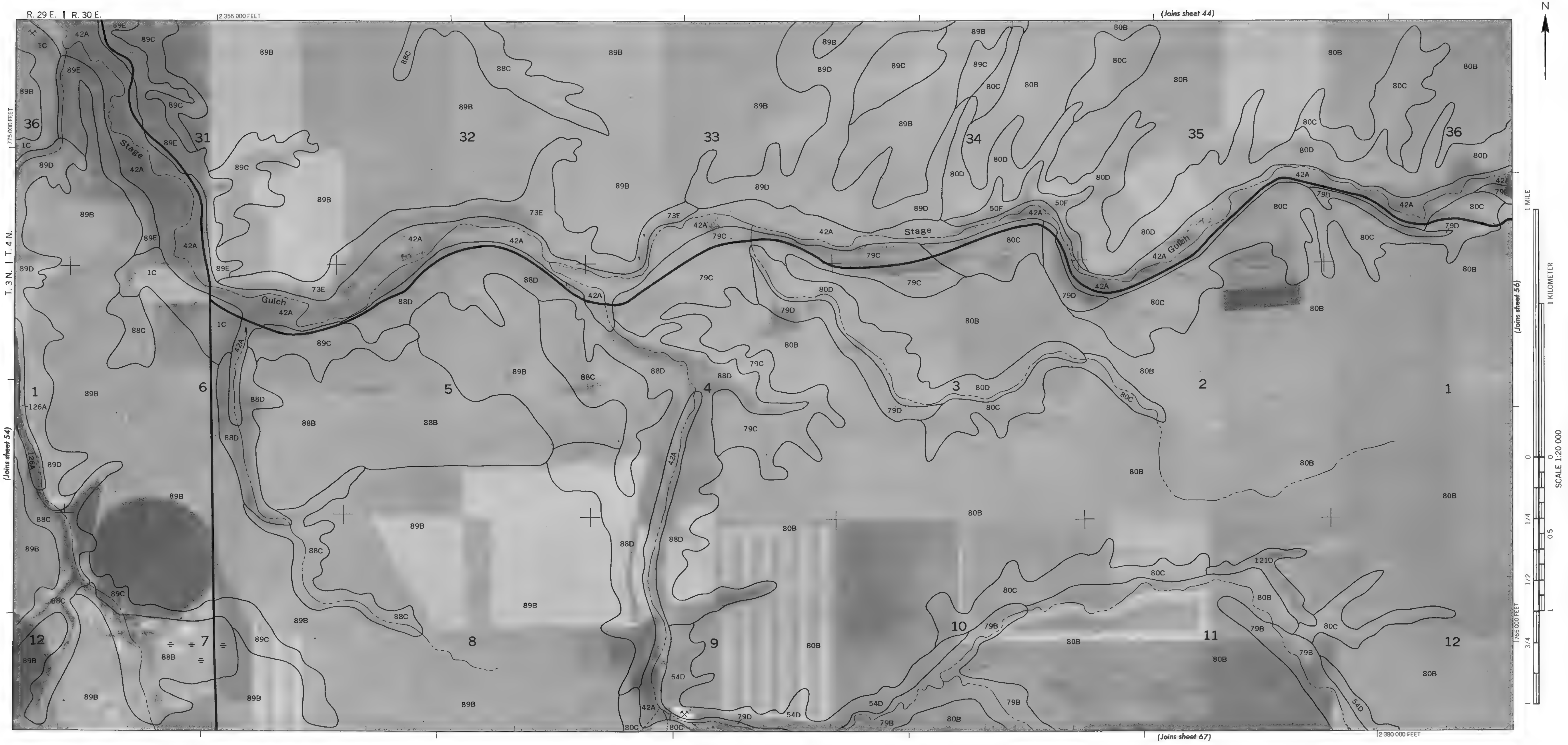


4000 AND 5000-FOOT GRID TICKS

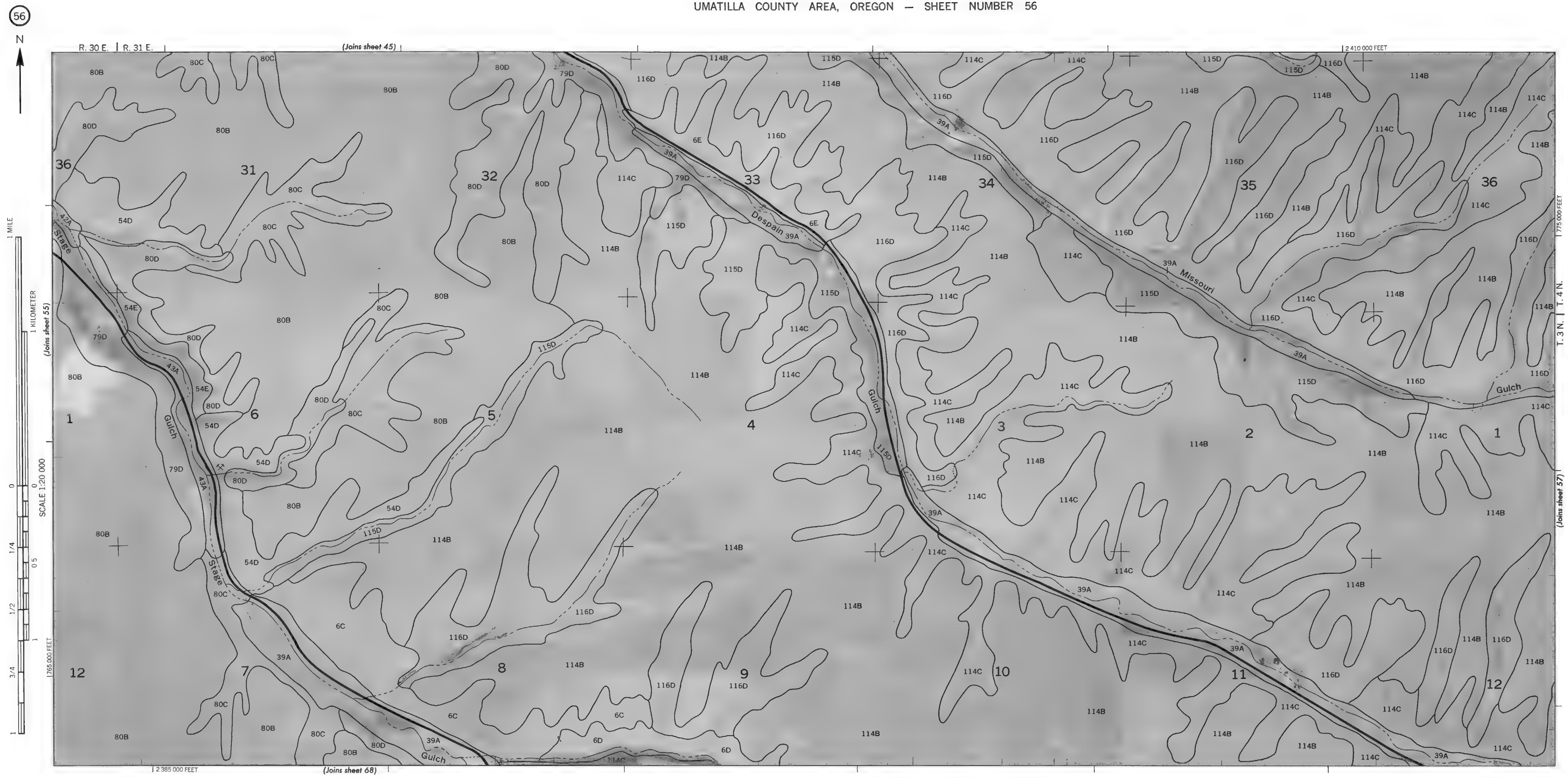
53

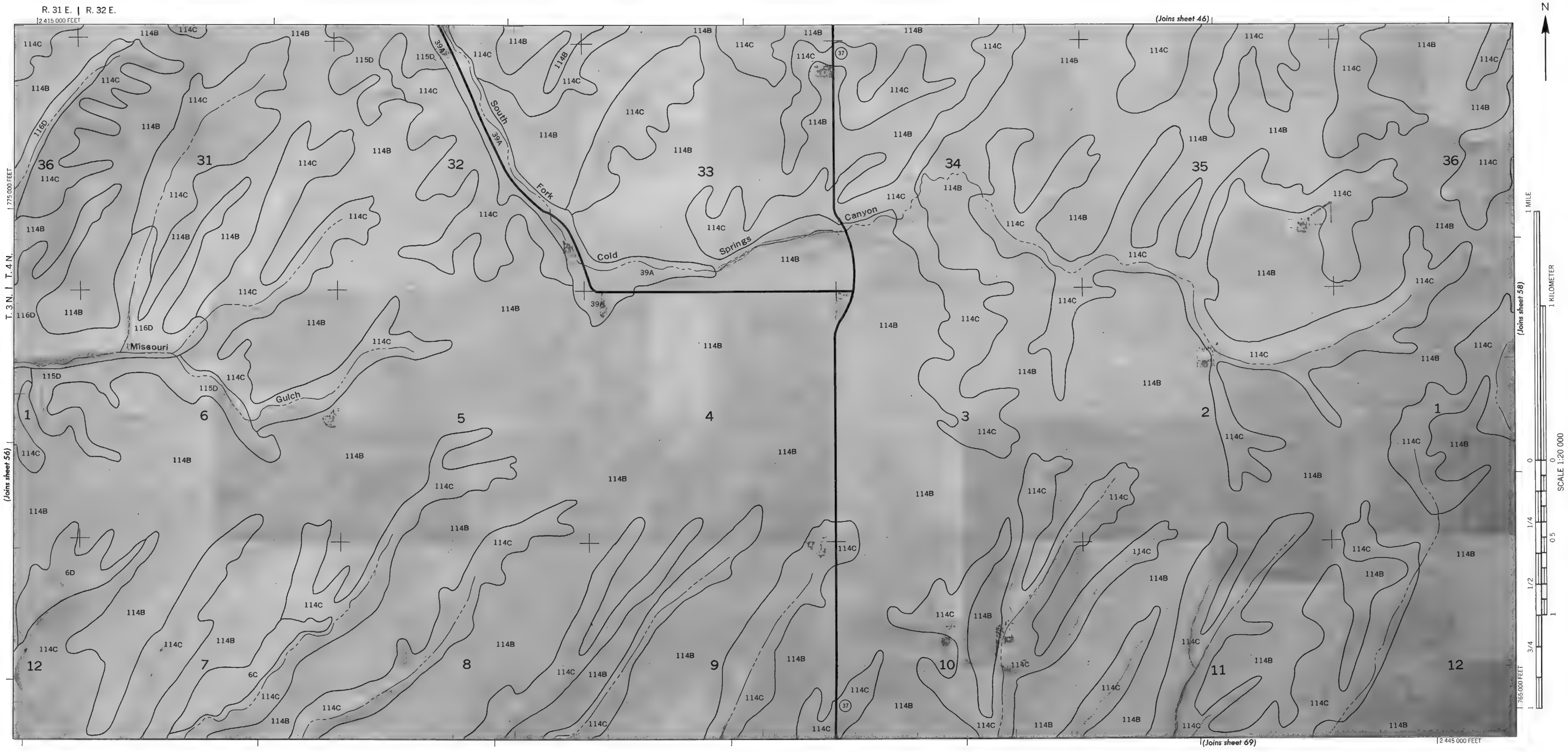

R. 27 E. | R. 28 E.
2 290 000 FEET
(Joins sheet 42)
N
175 000 FEET
T. 3 N. | T. 4 N.
(Joins inset, sheet 41)
(Joins sheet 54)
(Joins sheet 65)
2 315 000 FEET
765 000 FEET
UMATILLA RIVER
Bucks Corners
UMATILLA
MEADOWS
ECHO
MEADOWS
Emigrant Buttes
HIGH LINE CANAL
HUNT DITCH
Butter Creek
water
84
30
207
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
1 MILE
1 KILOMETER
SCALE 1:20 000


N
R. 28 E.
R. 29 E.
(Joins sheet 43)
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 66)
2 350 000 FEET
2 320 000 FEET
775 000 FEET
T. 3 N.
T. 4 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
UMATILLA
RIVER
UMATILLA
MEADOWS
ECHO
MEADOWS
STANFIELD
STANFIELD BRANCH FURNISH DITCH
FEED
CANAL
UNION
PACIFIC
FURNISH
DITCH
water
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
11
12
1B
1C
2C
15B
17A
27A
28A
42A
65A
66A
70
72A
74B
75B
87B
88B
88C
88D
89B
89C
89D
95B
119A
120C
126A

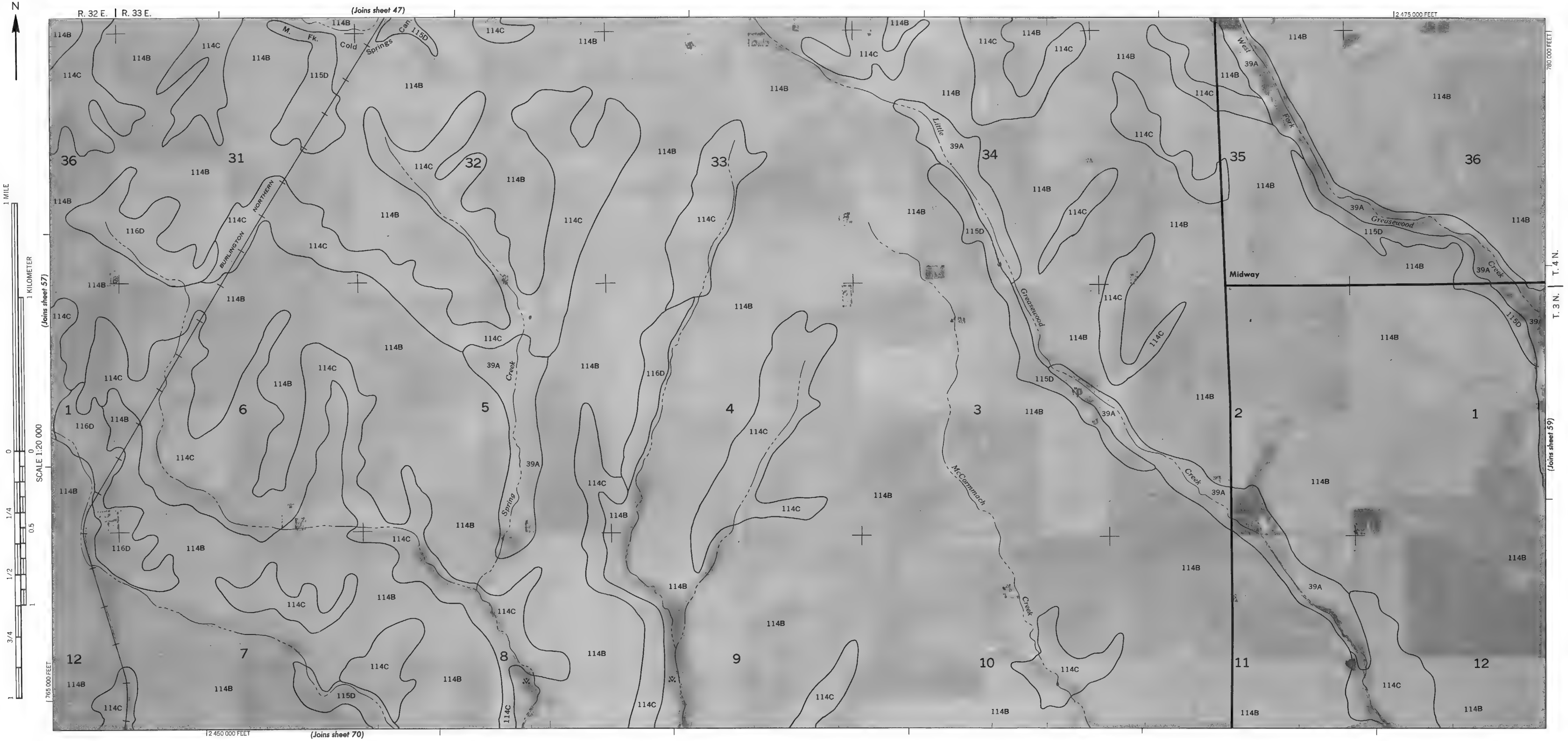


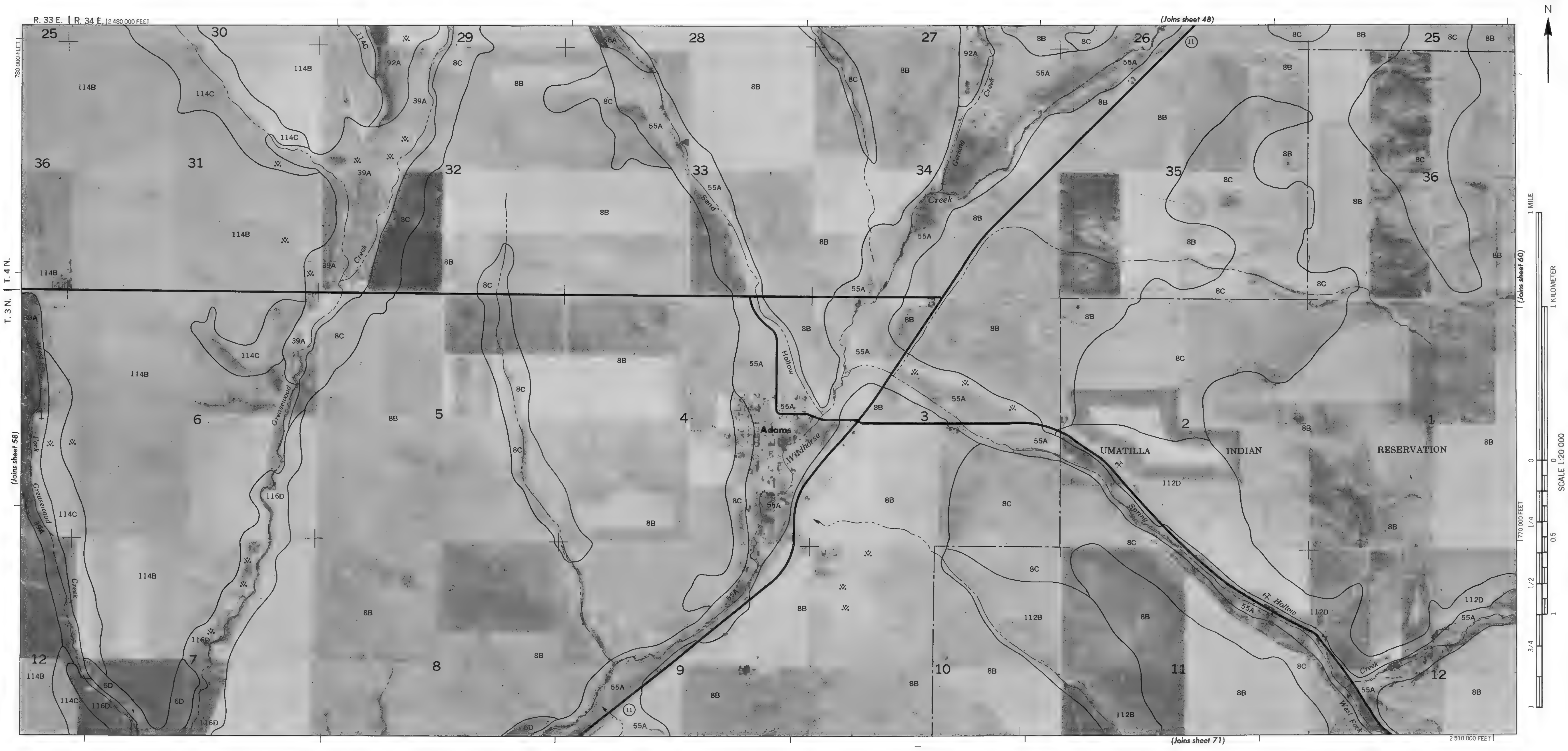
R. 29 E. | R. 30 E.
2 355 000 FEET
(Joins sheet 44)
T. 3 N. | T. 4 N.
775 000 FEET
(Joins sheet 54)
(Joins sheet 56)
(Joins sheet 67)
765 000 FEET
2 380 000 FEET
Stage Gulch
N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5


56
N
R. 30 E. | R. 31 E.
(Joins sheet 45)
2 410 000 FEET
(Joins sheet 55)
(Joins sheet 57)
(Joins sheet 68)
2 385 000 FEET
775 000 FEET
765 000 FEET
T. 4 N.
T. 3 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
Despain
Gulch
Missouri
Gulch
Stage
Gulch
Stage
Gulch
80B
80C
80D
79D
114B
114C
115D
116D
6E
39A
54D
54E
42A
43A
6C
6D
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
11
12

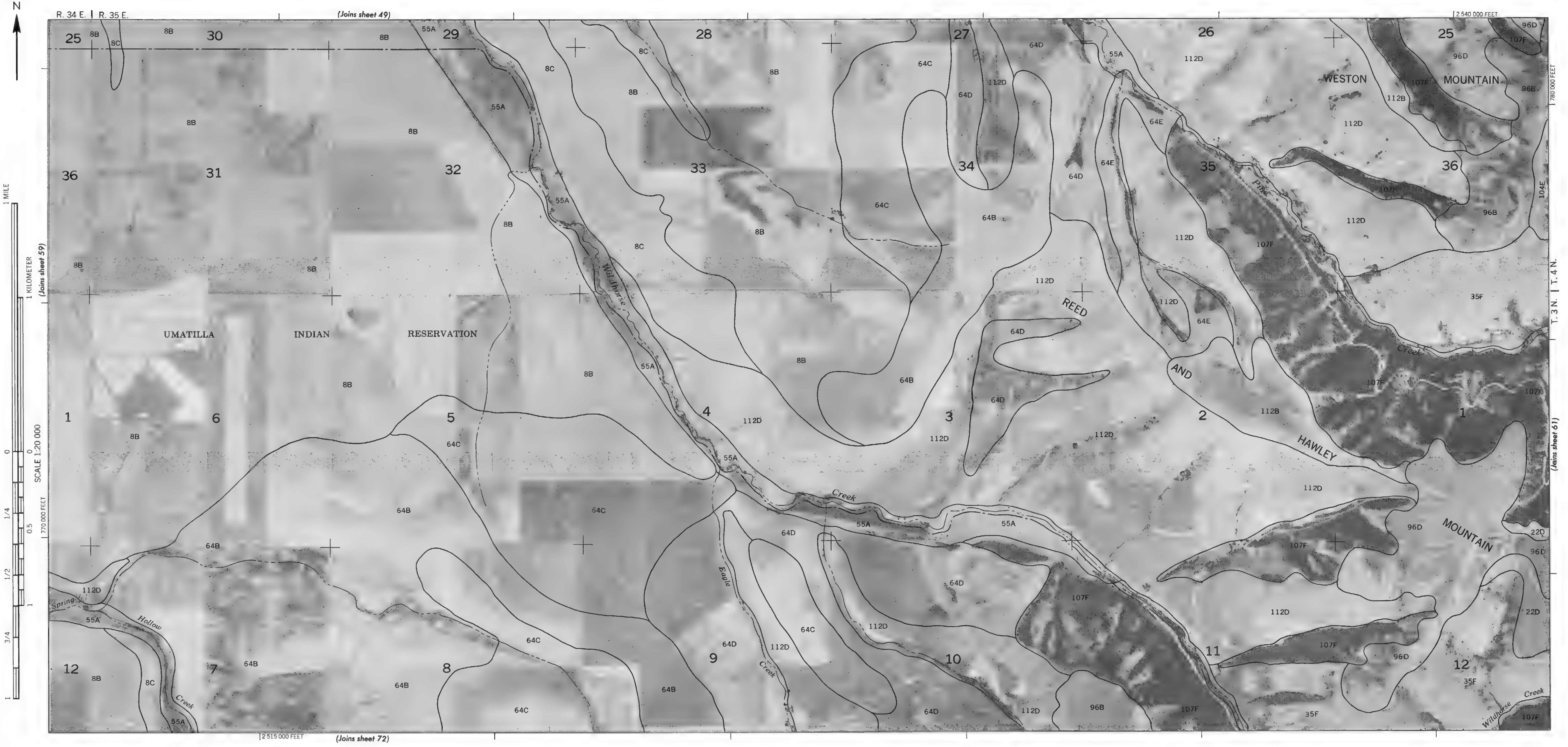

R. 31 E. | R. 32 E.
2 415 000 FEET
(Joins sheet 46)
(Joins sheet 56)
(Joins sheet 58)
(Joins sheet 69)
2 445 000 FEET
775 000 FEET
765 000 FEET
T. 4 N.
T. 3 N.
N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
0.5
1
South Fork
Cold Springs Canyon
Missouri Gulch
37
36
31
32
33
34
35
1
6
5
4
3
2
12
7
8
9
10
11
114B
114C
115D
116D
39A
6C
6D

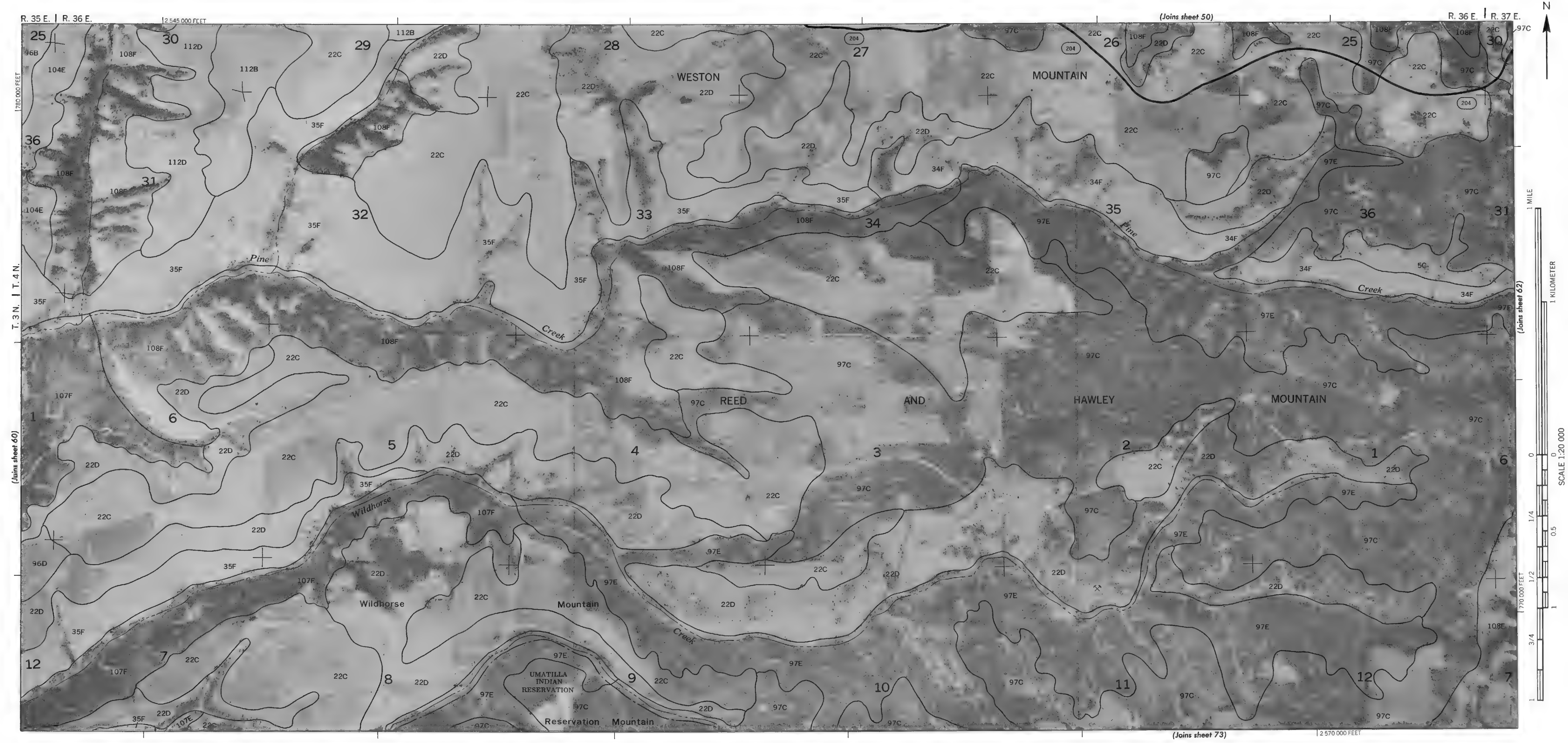
58


N
R. 32 E.
R. 33 E.
(Joins sheet 47)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 70)
2 475 000 FEET
780 000 FEET
765 000 FEET
2 450 000 FEET
T. 4 N.
T. 3 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
Midway
BURLINGTON NORTHERN
M. Fk. Cold Springs Can.
Spring Creek
Little Greasewood Creek
McCormmach Creek
West Fork Greasewood Creek
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
114B
114C
115D
116D
39A

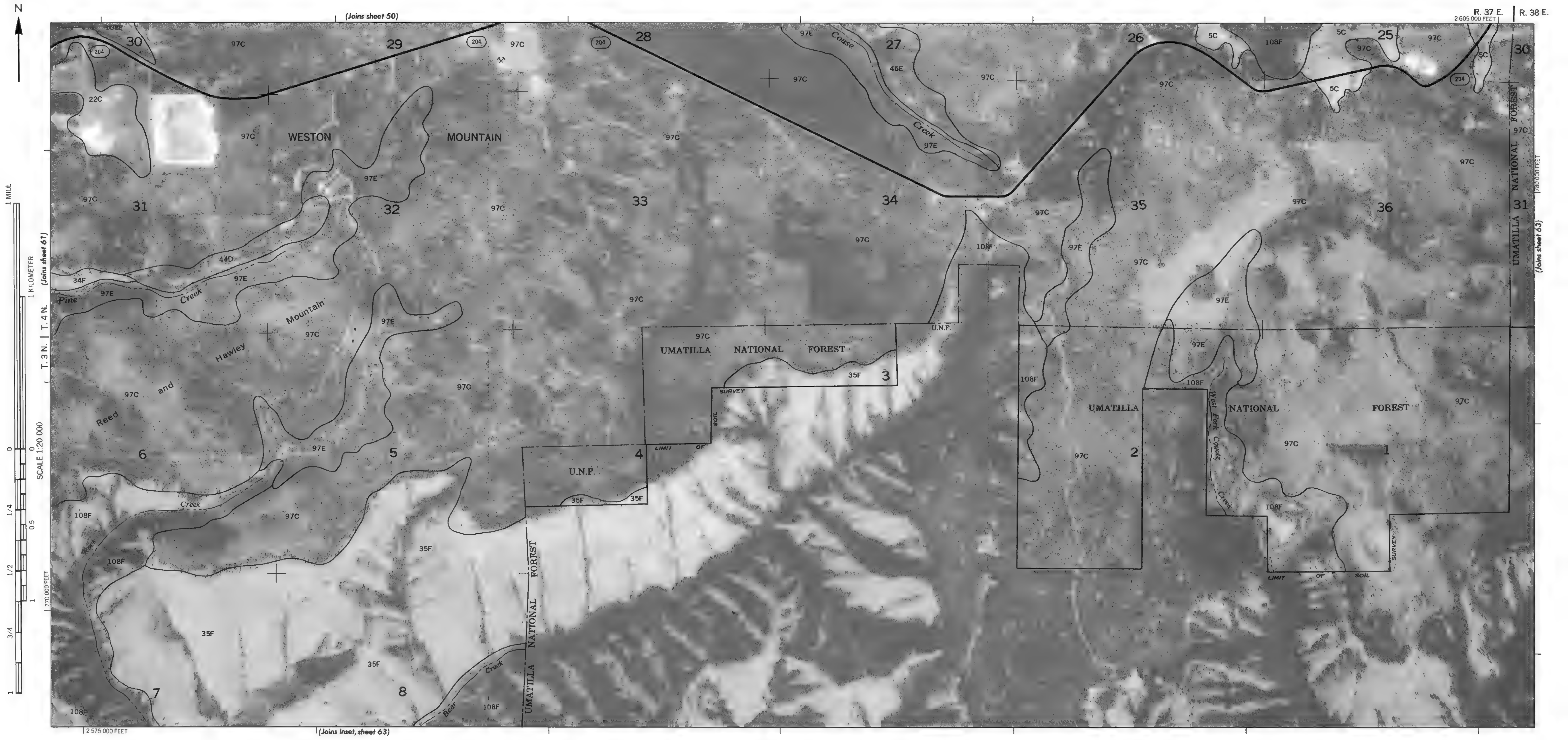


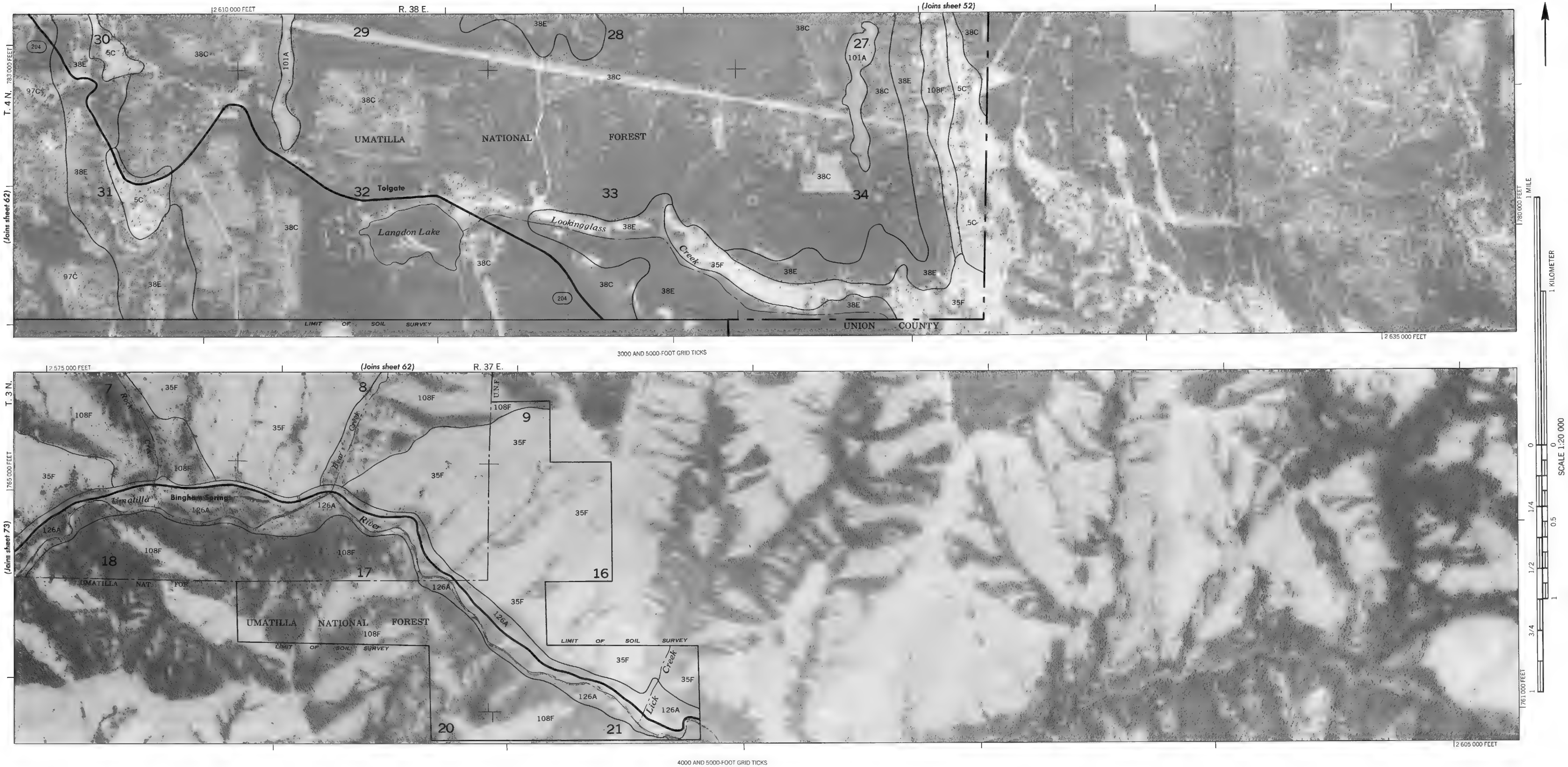
N
R. 33 E. | R. 34 E.
2 480 000 FEET
780 000 FEET
T. 4 N.
T. 3 N.
(Joins sheet 48)
(Joins sheet 58)
(Joins sheet 60)
(Joins sheet 71)
770 000 FEET
2 510 000 FEET
Adams
UMATILLA INDIAN RESERVATION
West Fork Greasewood Creek
Greasewood Creek
Sand Hollow
Wildhorse
Gerking Creek
Spring Hollow
West Fork
Creek
1 MILE
1 KILOMETER
SCALE 1:20 000

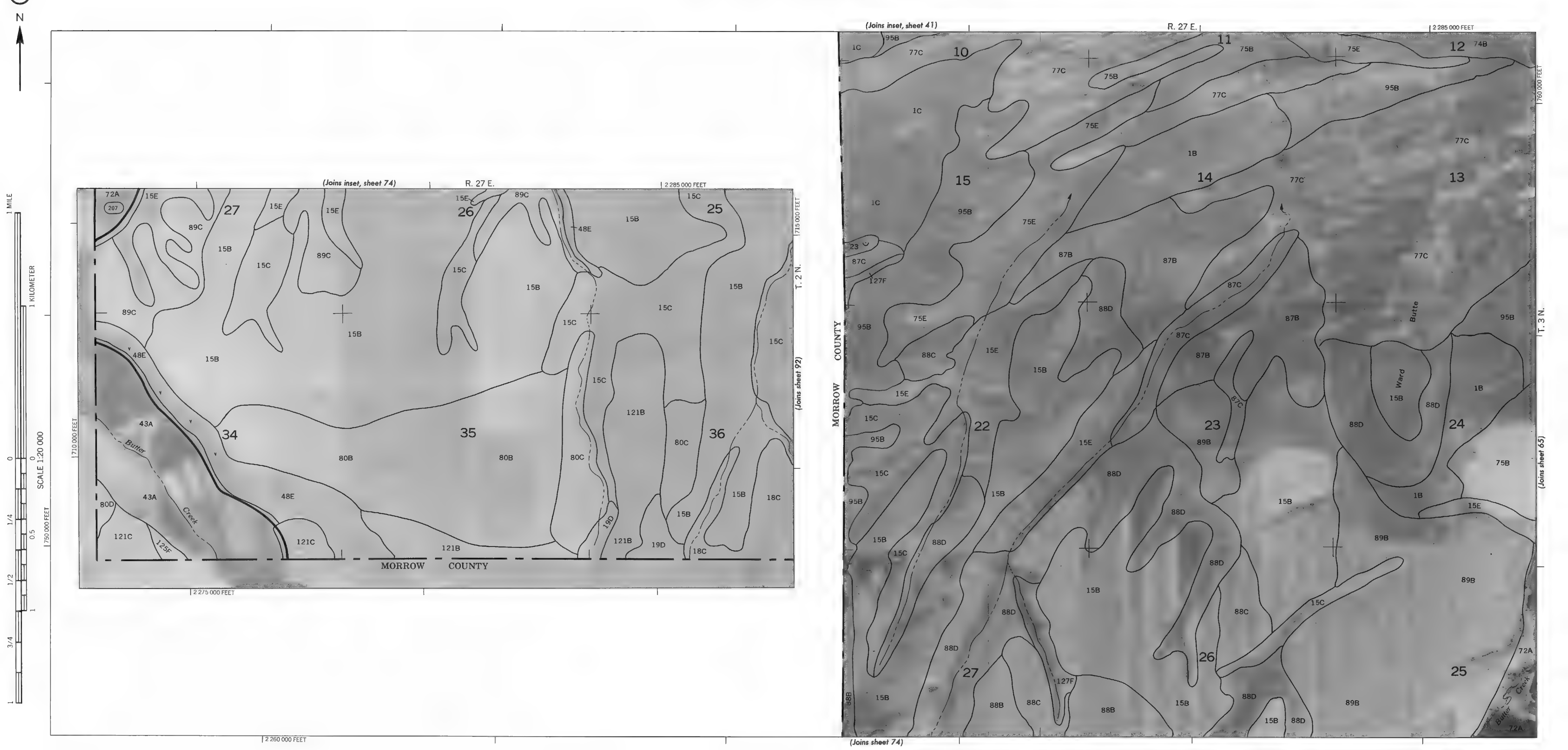

60
N
R. 34 E. | R. 35 E.
(Joins sheet 49)
(Joins sheet 59)
(Joins sheet 61)
(Joins sheet 72)
T. 4 N. | T. 3 N.
2 540 000 FEET
780 000 FEET
770 000 FEET
2 515 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
UMATILLA
INDIAN
RESERVATION
WESTON
MOUNTAIN
REED
AND
HAWLEY
MOUNTAIN
Wildhorse
Creek
Pine
Creek
Eagle
Creek
Spring
Hollow
Creek

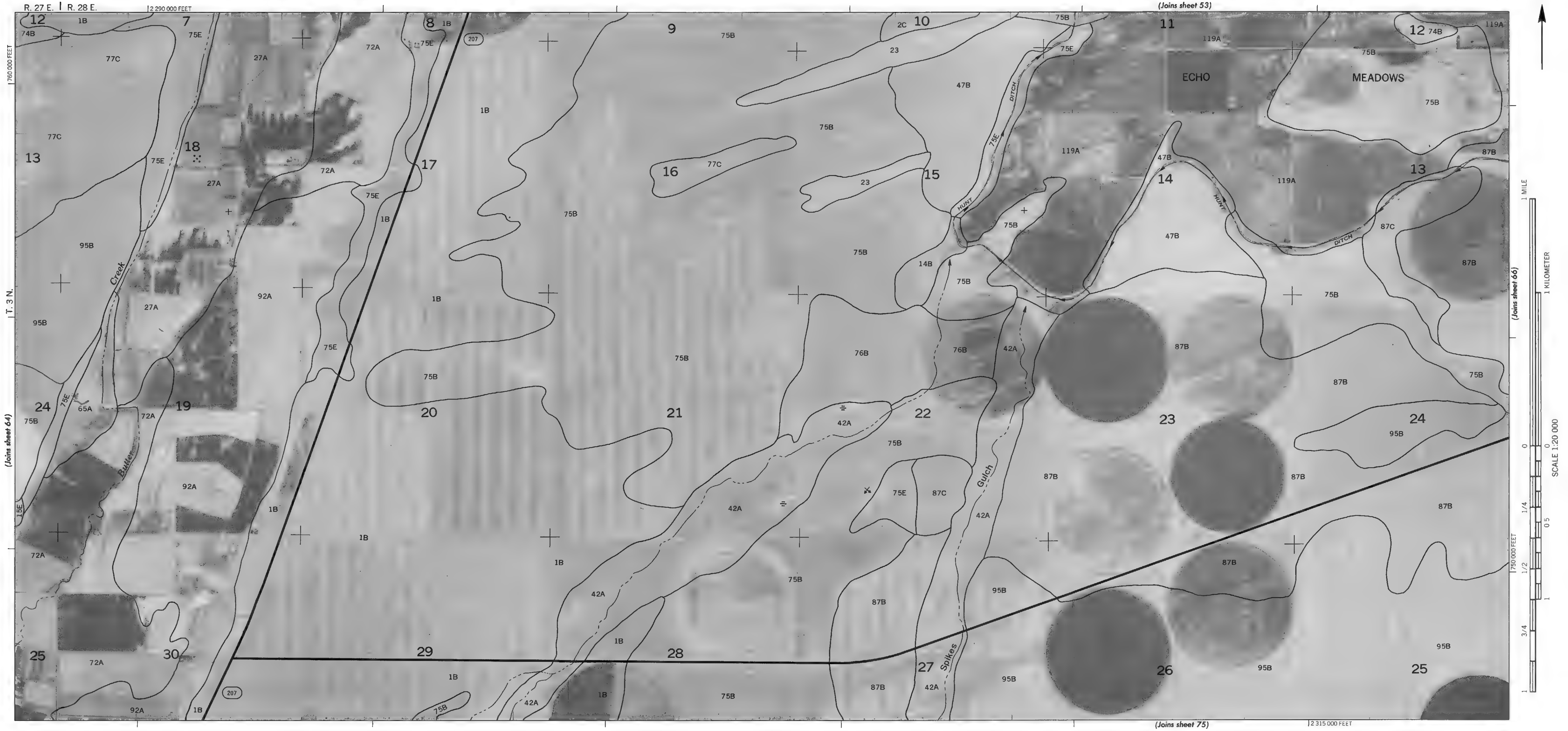

N
R. 35 E. | R. 36 E.
2 545 000 FEET
(Joins sheet 50)
R. 36 E. | R. 37 E.
780 000 FEET
T. 4 N.
T. 3 N.
(Joins sheet 60)
(Joins sheet 62)
(Joins sheet 73)
2 570 000 FEET
770 000 FEET
WESTON
MOUNTAIN
REED
AND
HAWLEY
MOUNTAIN
Pine
Creek
Wildhorse
Creek
Wildhorse
Mountain
UMATILLA
INDIAN
RESERVATION
Reservation
Mountain
204
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5

UMATILLA COUNTY AREA, OREGON — SHEET NUMBER 62

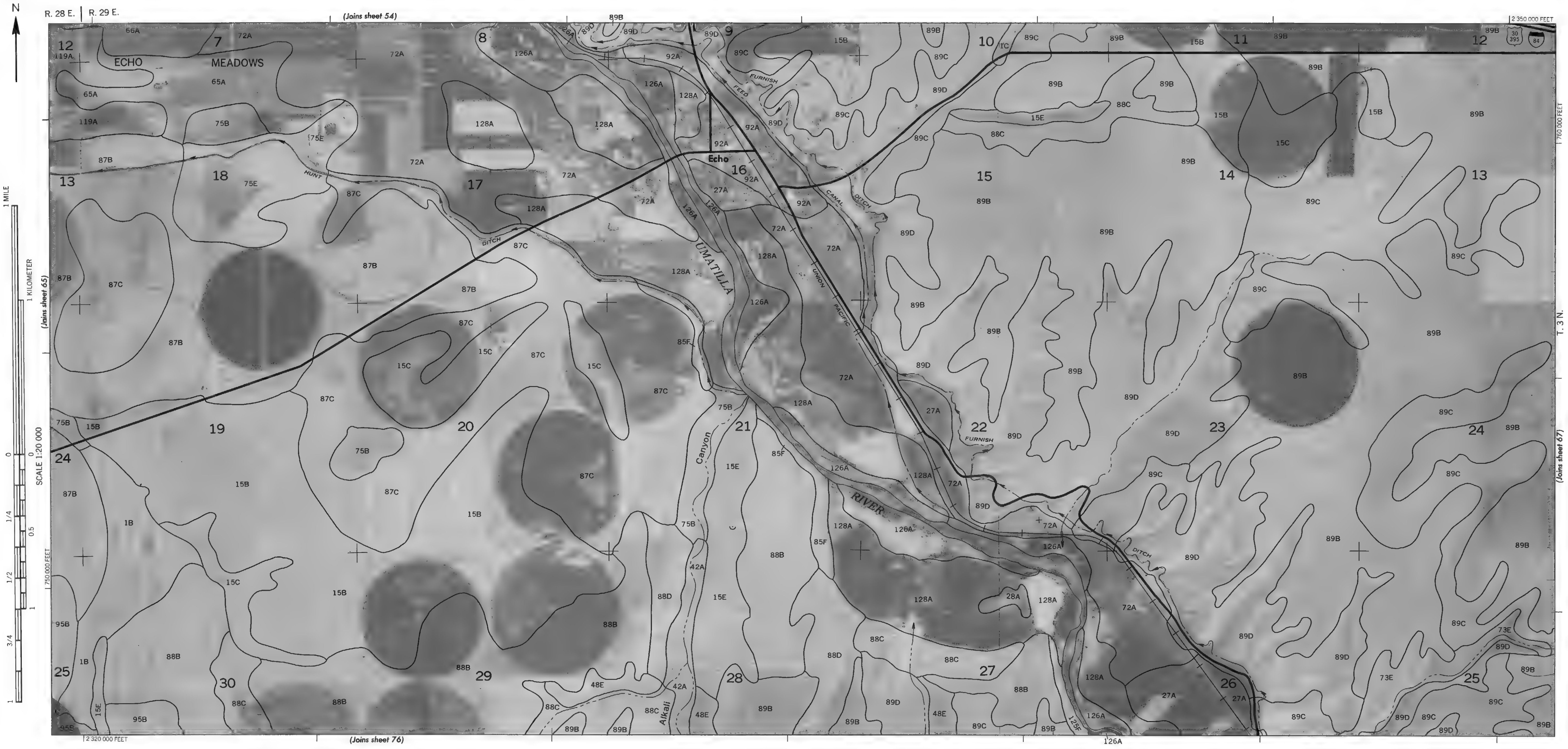


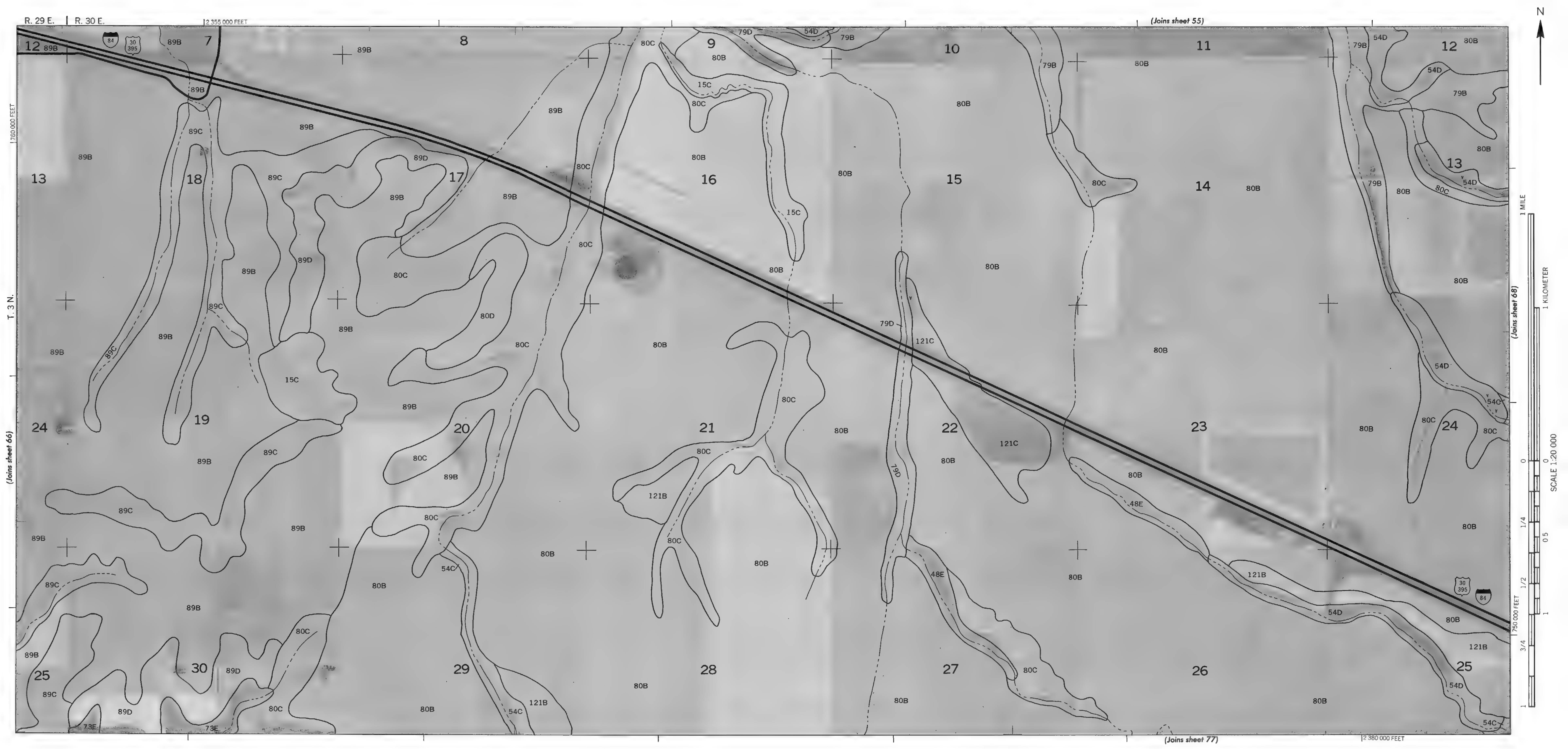

N
2 610 000 FEET
R. 38 E.
(Joins sheet 52)
T. 4 N.
783 000 FEET
(Joins sheet 62)
204
30
5C
38E
97C
38C
29
101A
38E
28
27
101A
38C
38E
108F
5C
UMATILLA
NATIONAL
FOREST
31
5C
32
Tolgate
33
34
Langdon Lake
Lookingglass
Creek
35F
38E
97C
38E
38C
204
5C
LIMIT OF SOIL SURVEY
UNION COUNTY
780 000 FEET
2 635 000 FEET
3000 AND 5000-FOOT GRID TICKS
2 575 000 FEET
(Joins sheet 62)
R. 37 E.
T. 3 N.
7
Rock
Creek
35F
108F
8
Bear
Creek
U.N.F.
9
765 000 FEET
(Joins sheet 73)
Umatilla
Bingham Spring
126A
River
18
17
16
UMATILLA NAT. FOR.
UMATILLA NATIONAL FOREST
LIMIT OF SOIL SURVEY
Lick
Creek
20
21
761 000 FEET
2 605 000 FEET
4000 AND 5000-FOOT GRID TICKS
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5

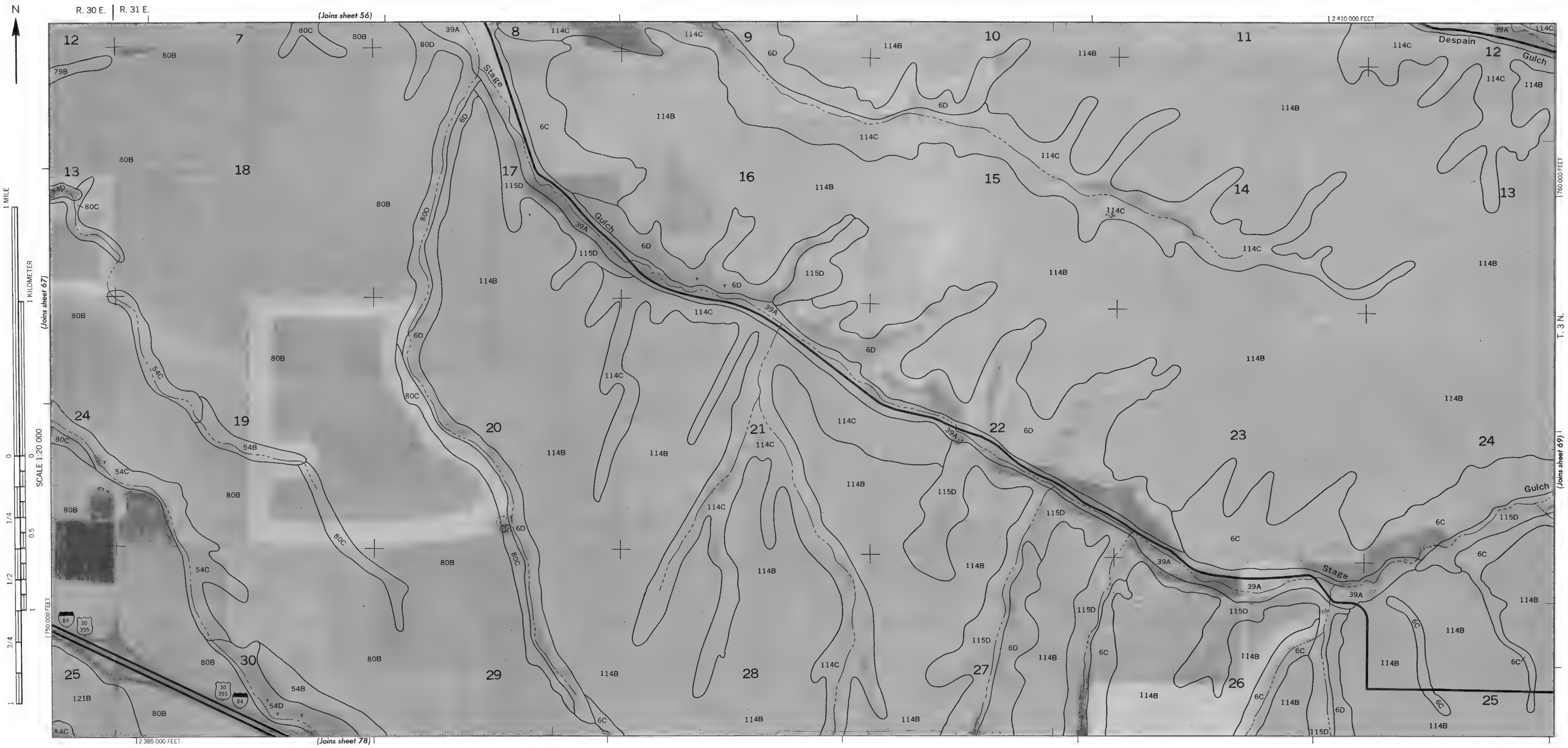

64
N
1 MILE
1 KILOMETER
SCALE 1:20 000
(Joins inset, sheet 74)
R. 27 E.
2 285 000 FEET
715 000 FEET
710 000 FEET
750 000 FEET
T. 2 N.
(Joins sheet 92)
MORROW COUNTY
2 275 000 FEET
Butter Creek
(Joins inset, sheet 41)
R. 27 E.
2 285 000 FEET
760 000 FEET
T. 3 N.
(Joins sheet 65)
MORROW COUNTY
Ward Butte
2 260 000 FEET
(Joins sheet 74)

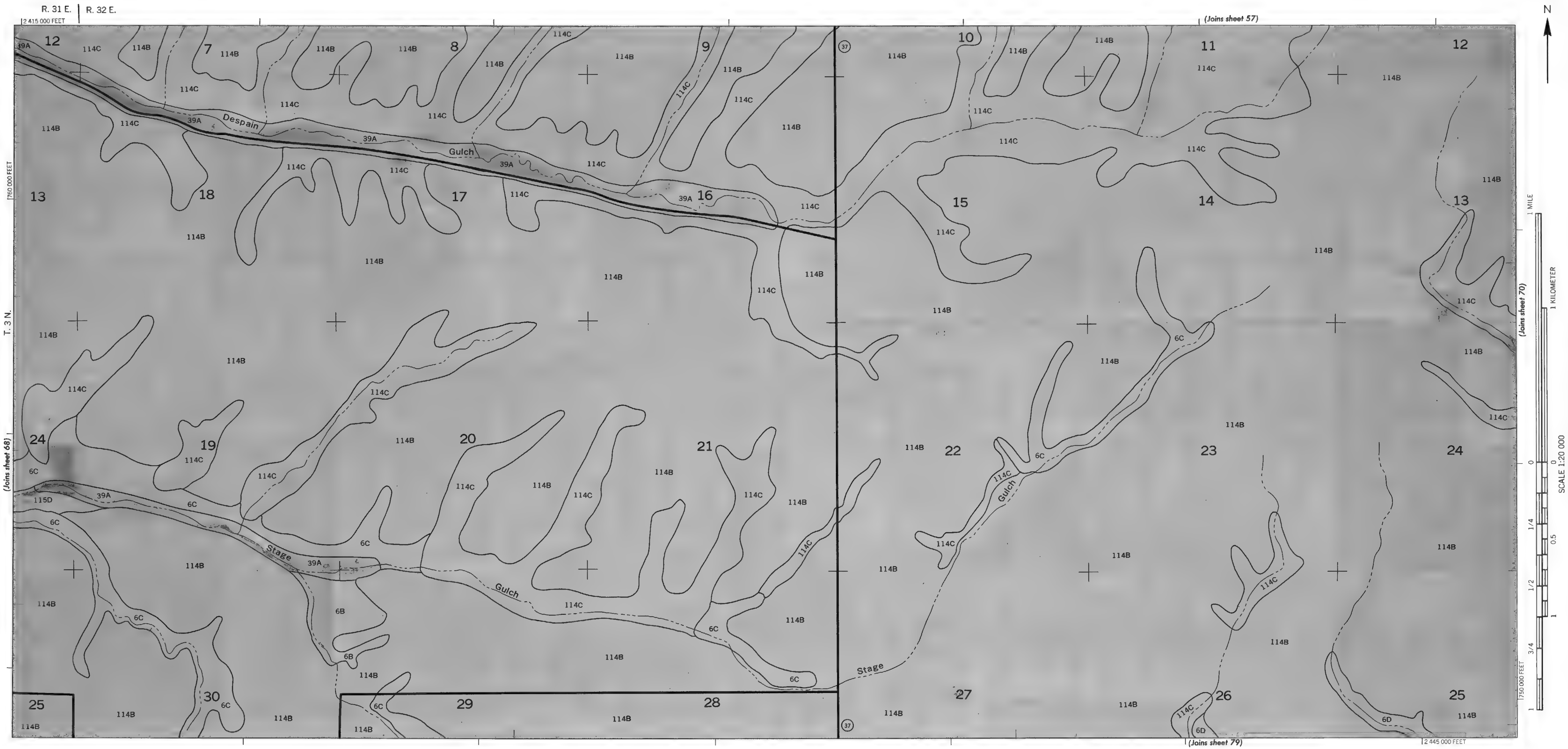


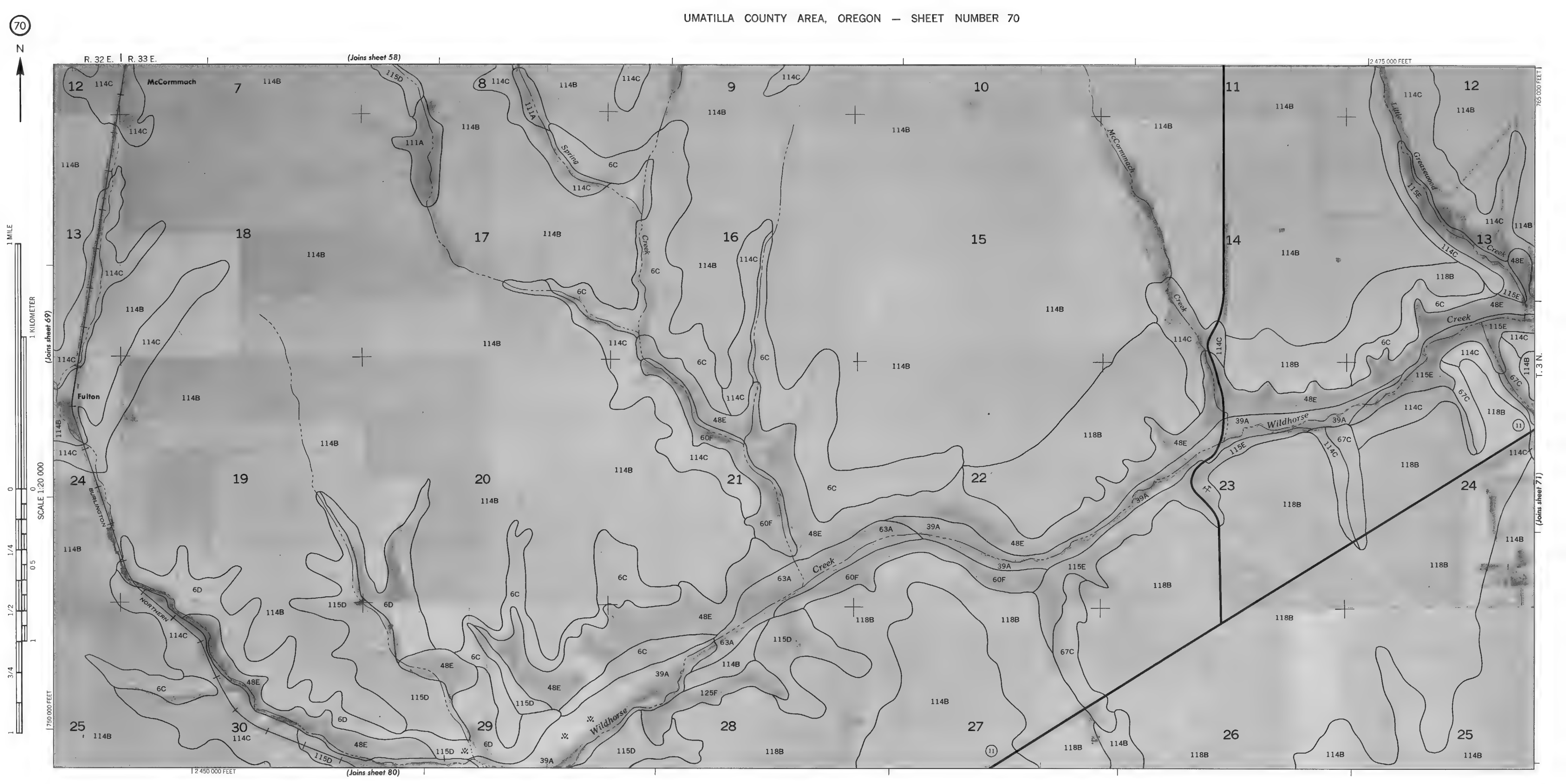
R. 27 E. | R. 28 E.
2 290 000 FEET
(Joins sheet 53)
(Joins sheet 64)
(Joins sheet 66)
(Joins sheet 75)
760 000 FEET
750 000 FEET
2 315 000 FEET
T. 3 N.
N
ECHO
MEADOWS
Butter Creek
HUNT DITCH
Spikes Gulch
207
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5

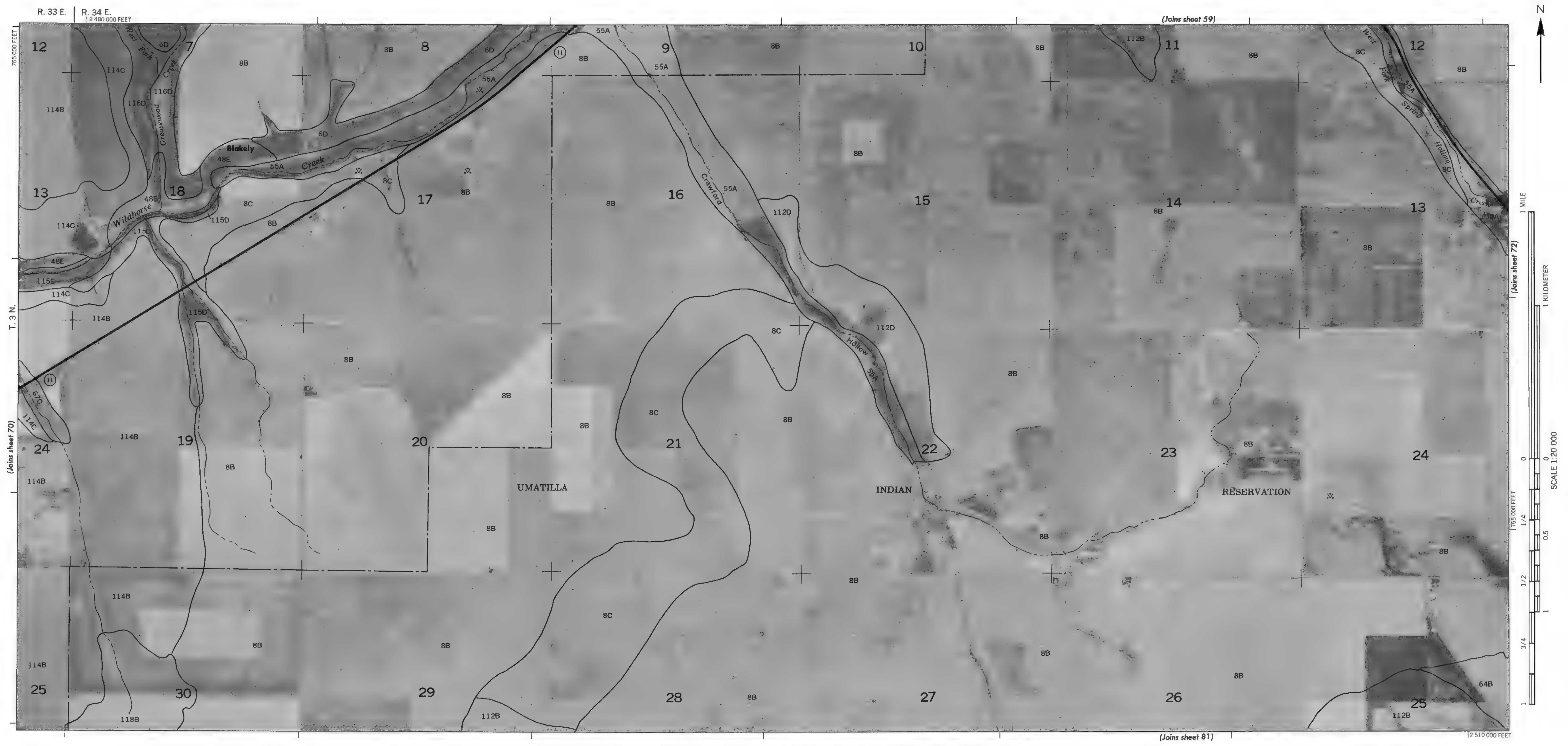

N
R. 28 E.
R. 29 E.
(Joins sheet 54)
(Joins sheet 65)
(Joins sheet 67)
(Joins sheet 76)
T. 3 N.
2 350 000 FEET
2 320 000 FEET
760 000 FEET
750 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
ECHO
MEADOWS
Echo
HUNT
DITCH
FURNISH
FEED
CANAL
UNION
PACIFIC
UMATILLA
RIVER
Canyon
Alkali
12
7
8
9
10
11
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
66A
72A
65A
65A
119A
119A
75B
75E
87B
87C
75E
126A
128A
92A
89B
89C
89D
15B
15C
15E
88C
88B
88D
85F
27A
28A
42A
48E
1B
95B
73E
126A

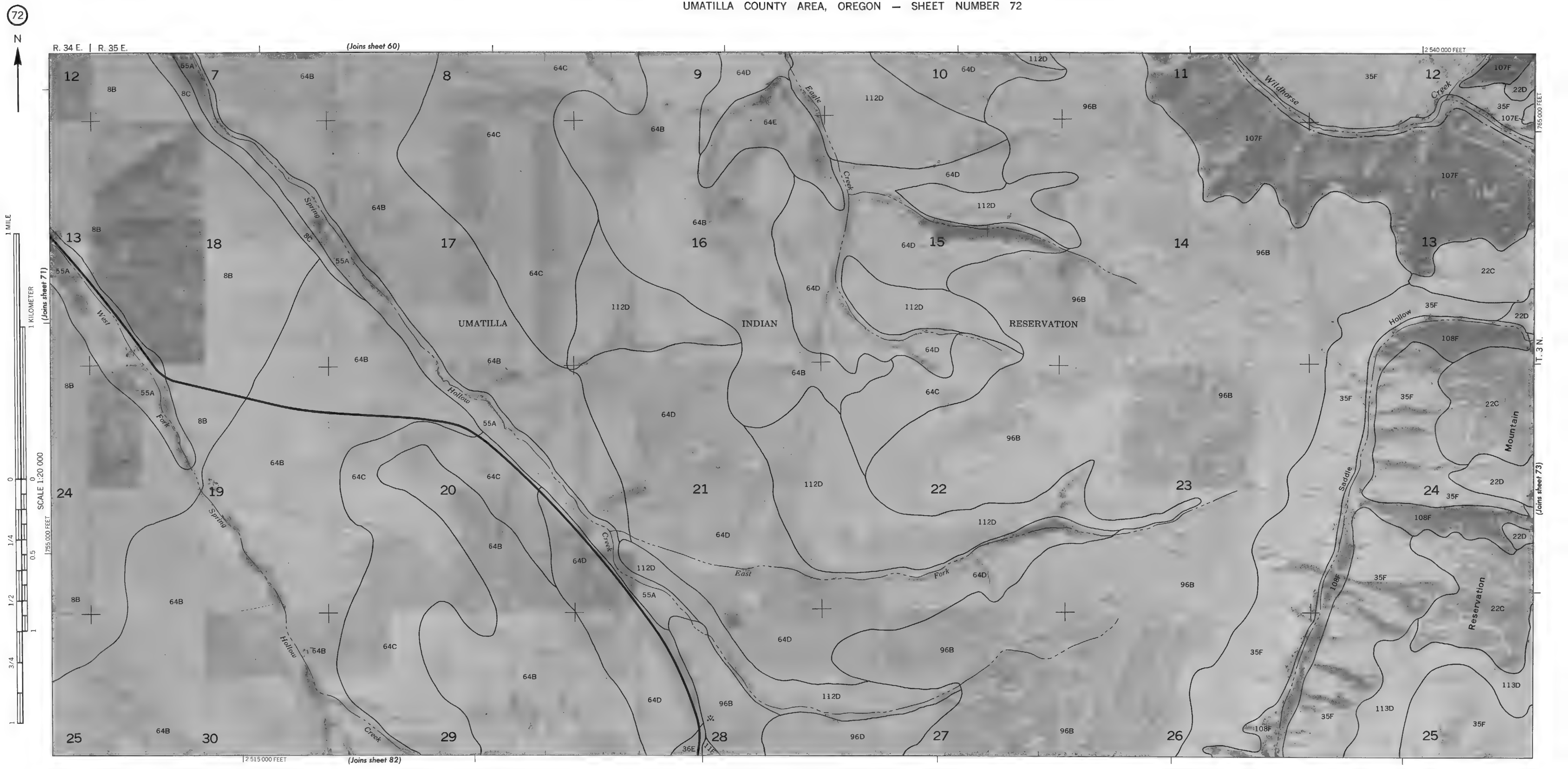

R. 29 E.
R. 30 E.
2 355 000 FEET
(Joins sheet 55)
760 000 FEET
T. 3 N.
(Joins sheet 66)
(Joins sheet 68)
(Joins sheet 77)
2 380 000 FEET
750 000 FEET
N
1 MILE
1 KILOMETER
SCALE 1:20 000
84
30
395
12
7
8
9
10
11
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
89B
89C
89D
80B
80C
80D
79B
79D
54C
54D
48E
15C
121B
121C
73E

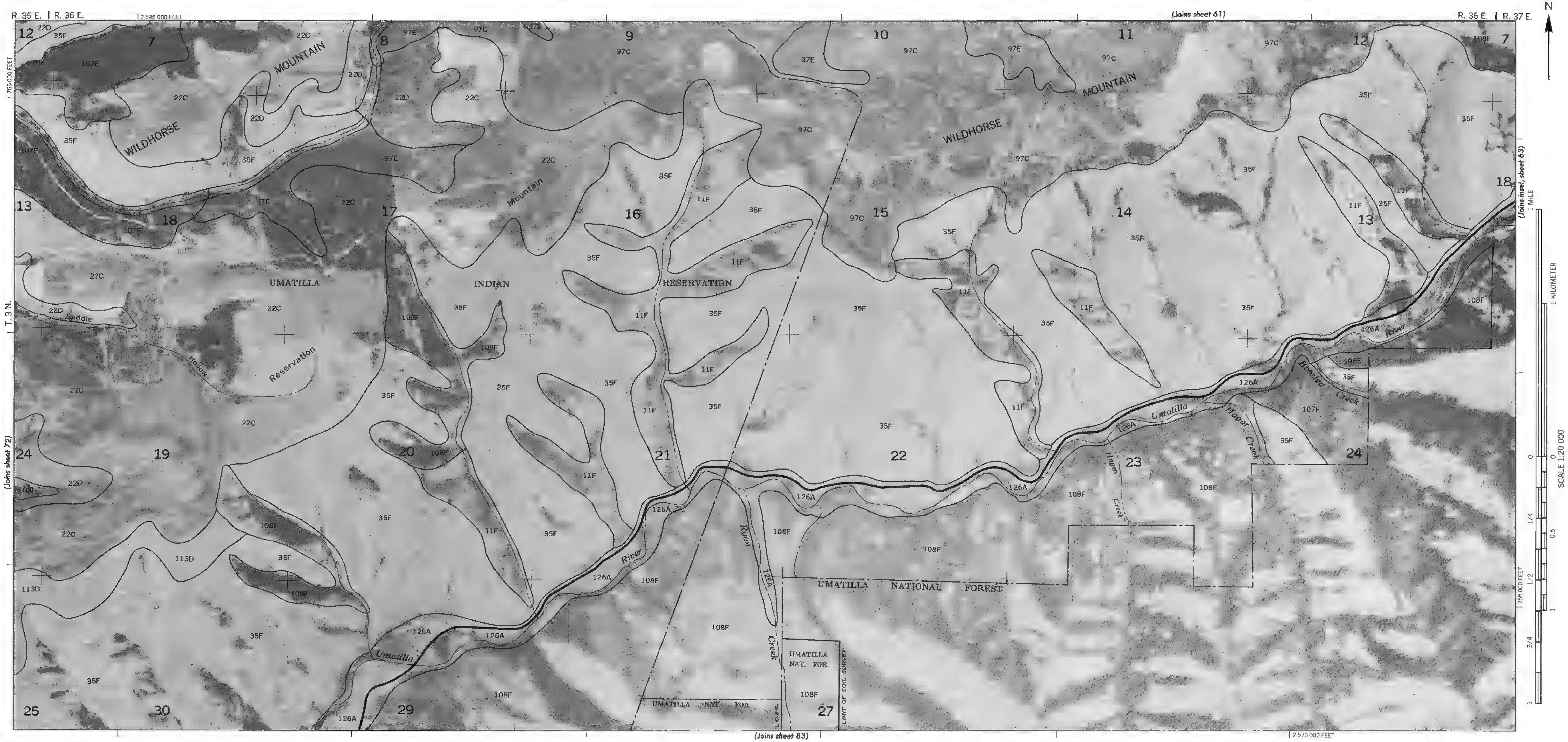

N
R. 30 E.
R. 31 E.
(Joins sheet 56)
(Joins sheet 67)
(Joins sheet 69)
(Joins sheet 78)
2 410 000 FEET
2 385 000 FEET
750 000 FEET
T. 3 N.
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Stage Gulch
Despain Gulch
84
30
395
12
7
8
9
10
11
13
18
17
16
15
14
24
19
20
21
22
23
25
30
29
28
27
26
79B
80B
80C
80D
39A
6C
6D
54C
54B
54D
114B
114C
115D
121B

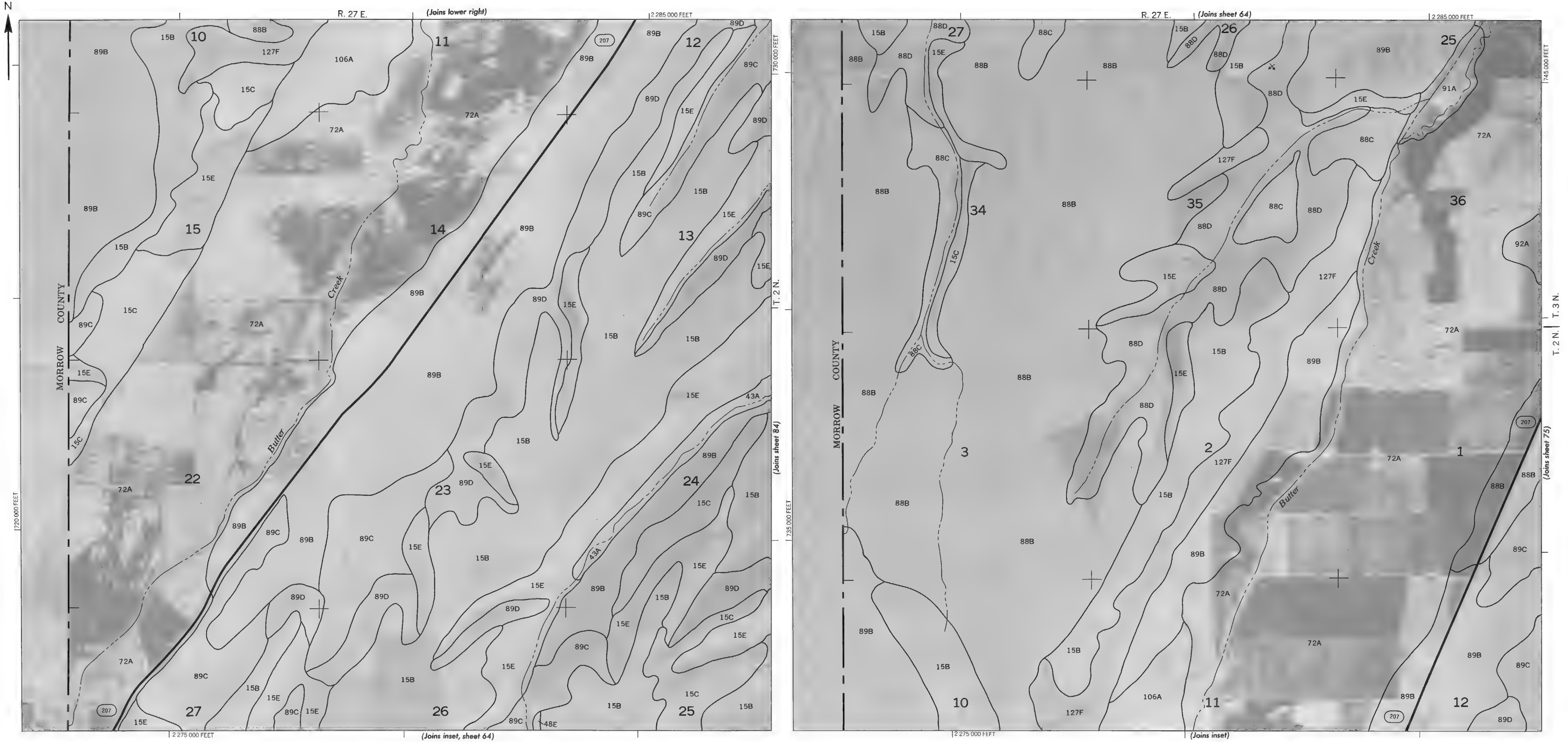

69
R. 31 E.
R. 32 E.
2 415 000 FEET
(Joins sheet 57)
(Joins sheet 68)
(Joins sheet 70)
(Joins sheet 79)
2 445 000 FEET
750 000 FEET
T. 3 N.
N
37
Despain
Gulch
Stage
Gulch
Stage
Gulch
39A
114B
114C
6B
6C
6D
115D
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5


70
N
R. 32 E.
R. 33 E.
(Joins sheet 58)
(Joins sheet 80)
(Joins sheet 69)
(Joins sheet 71)
T. 3 N.
2 475 000 FEET
2 450 000 FEET
765 000 FEET
750 000 FEET
McCormmach
Fulton
BURLINGTON
NORTHERN
Spring
Creek
McCormmach
Creek
Little
Greasewood
Creek
Wildhorse
Creek
1 MILE
1 KILOMETER
SCALE 1:20 000

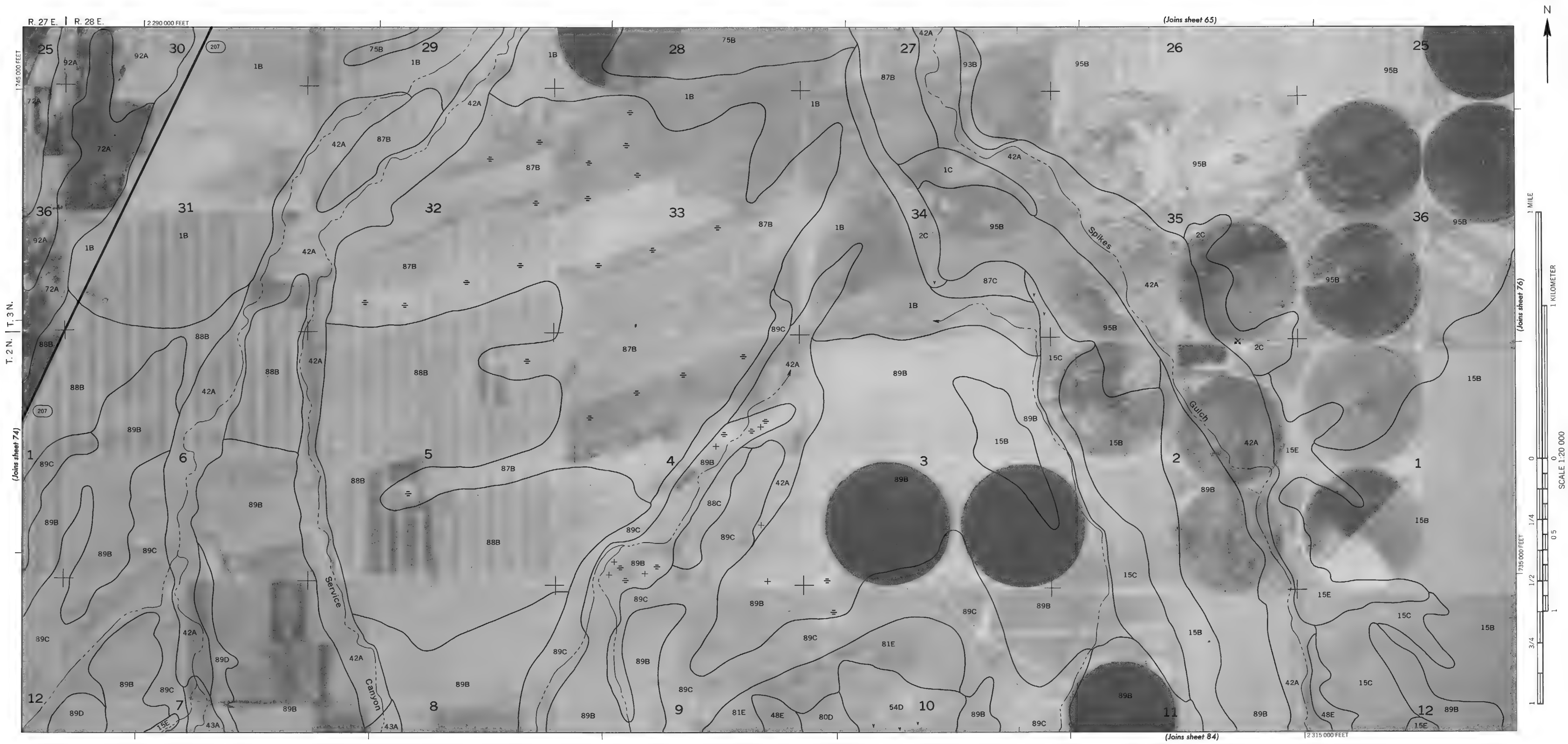

71
N
R. 33 E.
R. 34 E.
2 480 000 FEET
755 000 FEET
(Joins sheet 59)
(Joins sheet 72)
(Joins sheet 70)
(Joins sheet 81)
2 510 000 FEET
T. 3 N.
West Fork
Greasewood Creek
Blakely
Creek
Wildhorse
Crawford
Hollow
West Fork Spring Hollow Creek
UMATILLA
INDIAN
RESERVATION
1 MILE
1 KILOMETER
SCALE 1:20 000

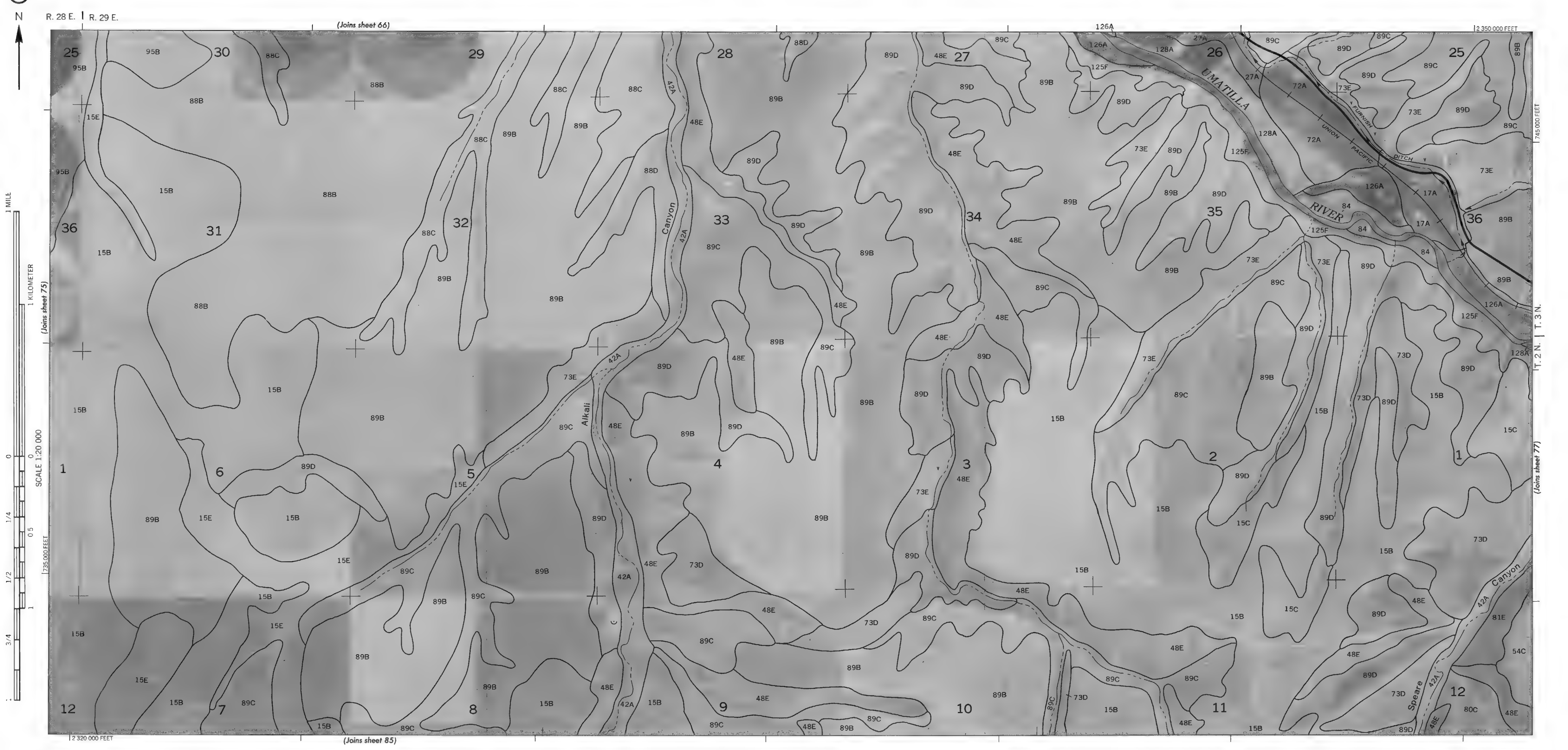

72
N
R. 34 E. | R. 35 E.
(Joins sheet 60)
(Joins sheet 71)
(Joins sheet 73)
(Joins sheet 82)
T. 3 N.
2 540 000 FEET
2 515 000 FEET
755 000 FEET
765 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
UMATILLA
INDIAN
RESERVATION
Spring Hollow
West Fork
Eagle Creek
East Fork
Wildhorse Creek
Saddle Hollow
Mountain
Reservation
Spring Hollow Creek

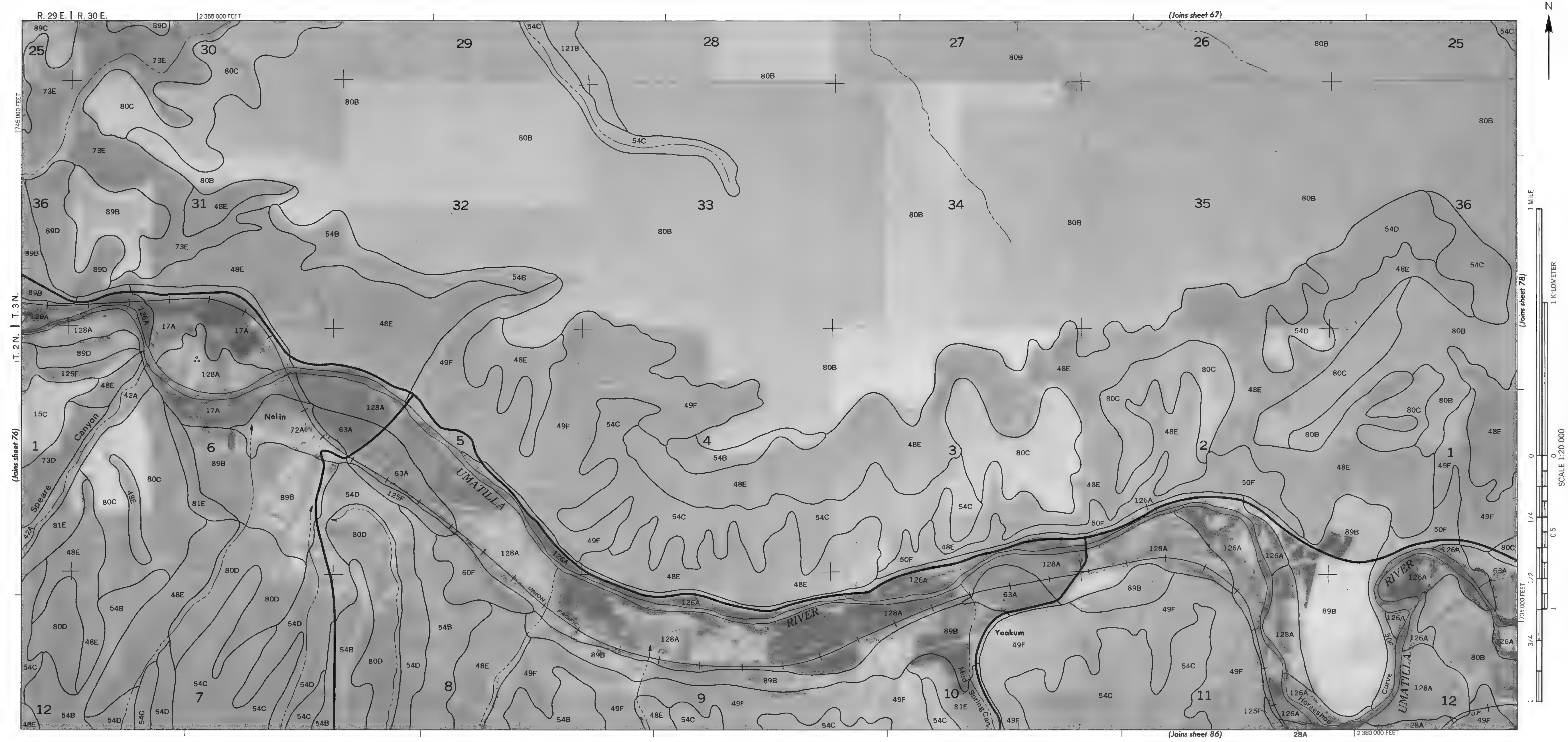

R. 35 E. | R. 36 E.
(Joins sheet 61)
R. 36 E. | R. 37 E.
N
WILDHORSE MOUNTAIN
WILDHORSE MOUNTAIN
Mountain
UMATILLA INDIAN RESERVATION
Saddle Hollow
Reservation
T. 3 N.
(Joins sheet 72)
(Joins inset, sheet 63)
Umatilla River
Ryan Creek
Hagar Creek
Bobsled Creek
UMATILLA NATIONAL FOREST
UMATILLA NAT. FOR.
UMATILLA NAT. FOR.
LIMIT OF SOIL SURVEY
(Joins sheet 83)
1 MILE
1 KILOMETER
SCALE 1:20 000

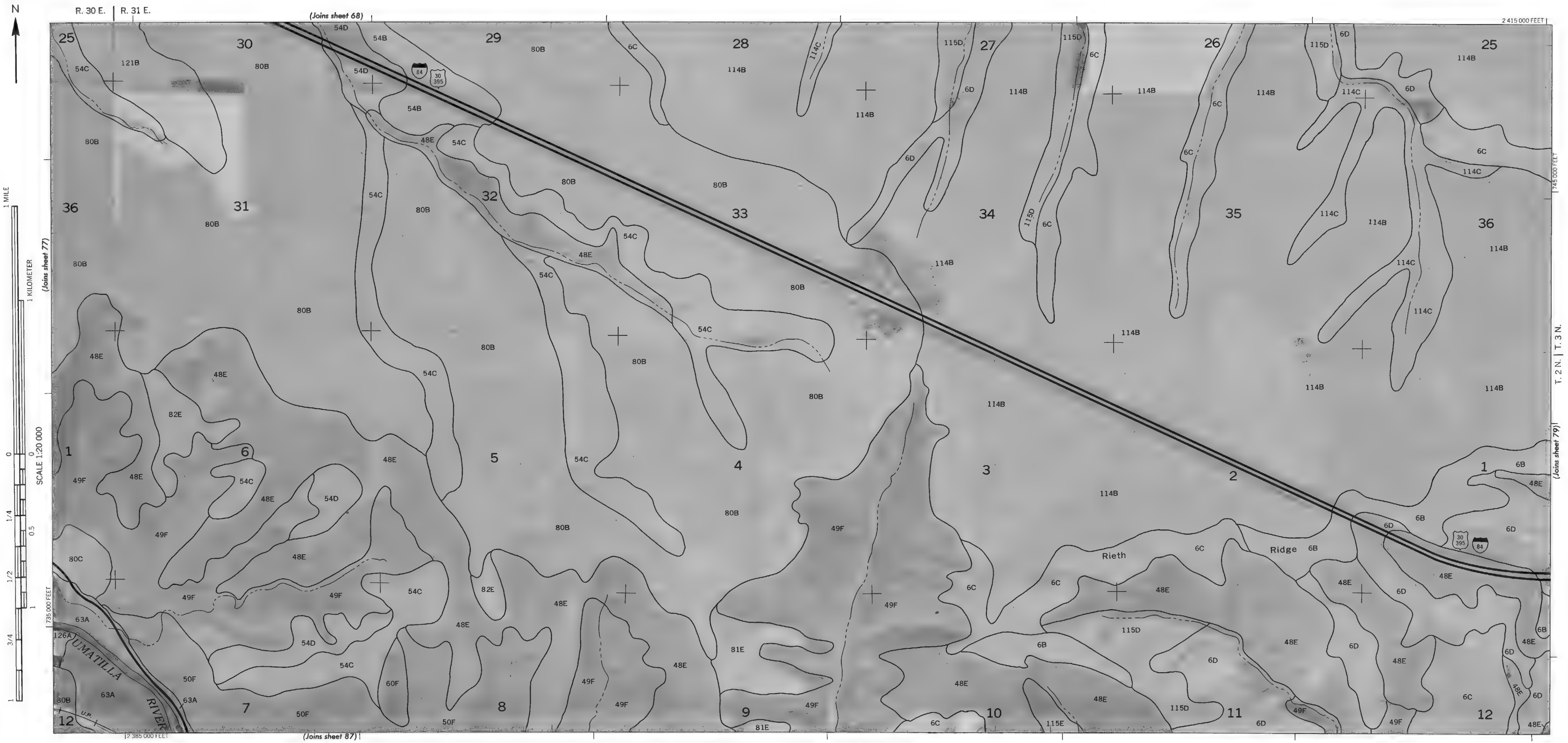

N
R. 27 E.
(Joins lower right)
2 285 000 FEET
730 000 FEET
T. 2 N.
(Joins sheet 84)
720 000 FEET
2 275 000 FEET
(Joins inset, sheet 64)
MORROW COUNTY
Butter Creek
207
R. 27 E.
(Joins sheet 64)
2 285 000 FEET
745 000 FEET
T. 3 N.
T. 2 N.
(Joins sheet 75)
735 000 FEET
2 275 000 FEET
(Joins inset)
MORROW COUNTY
Butter Creek
207
10
11
12
13
14
15
22
23
24
25
26
27
34
35
36
1
2
3
15B
15C
15E
43A
48E
72A
88B
88C
88D
89B
89C
89D
91A
92A
106A
127F

75

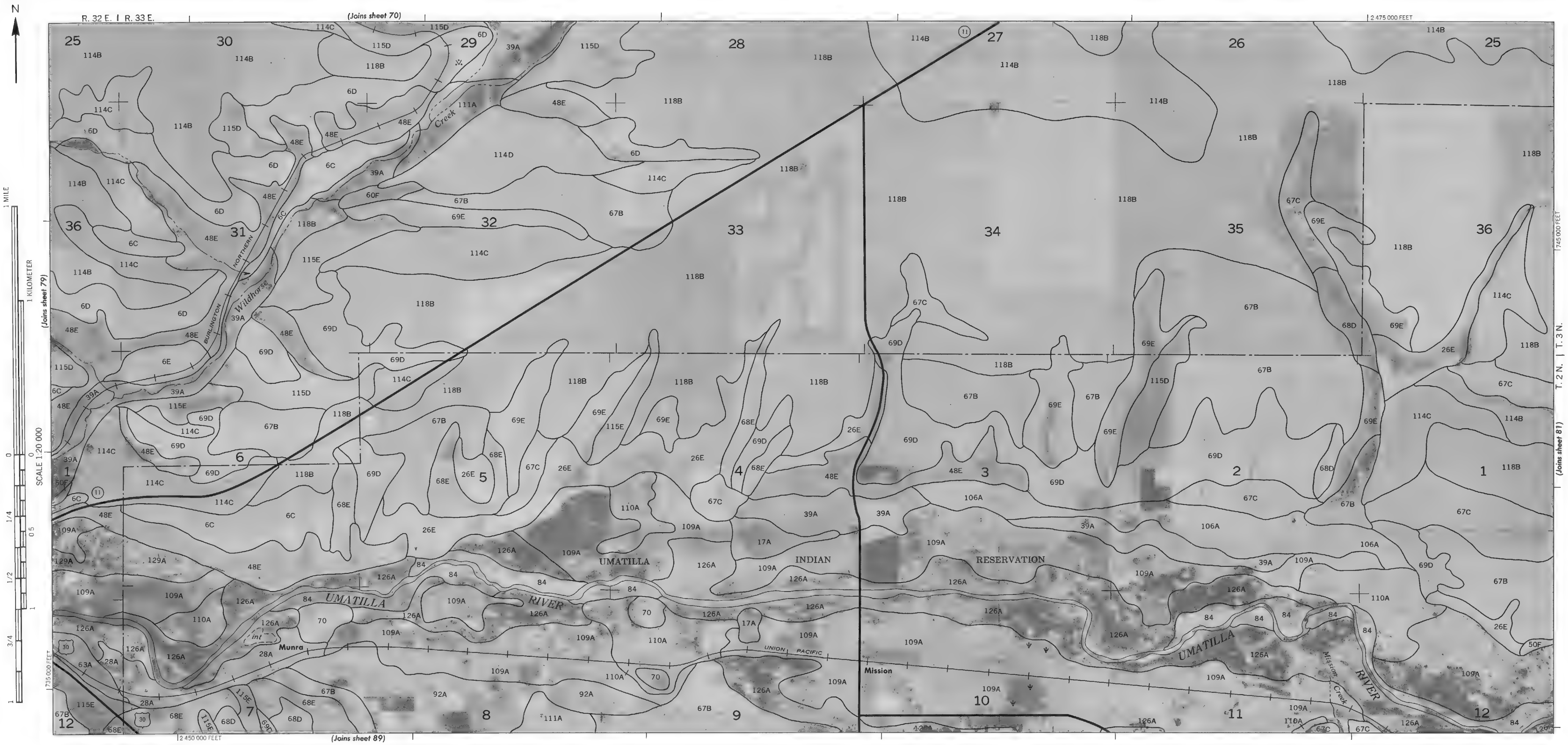

R. 27 E.
R. 28 E.
2 290 000 FEET
745 000 FEET
(Joins sheet 65)
(Joins sheet 76)
(Joins sheet 74)
(Joins sheet 84)
2 315 000 FEET
735 000 FEET
T. 3 N.
T. 2 N.
N
Spikes
Gulch
Service
Canyon
207
1 MILE
1 KILOMETER
SCALE 1:20 000

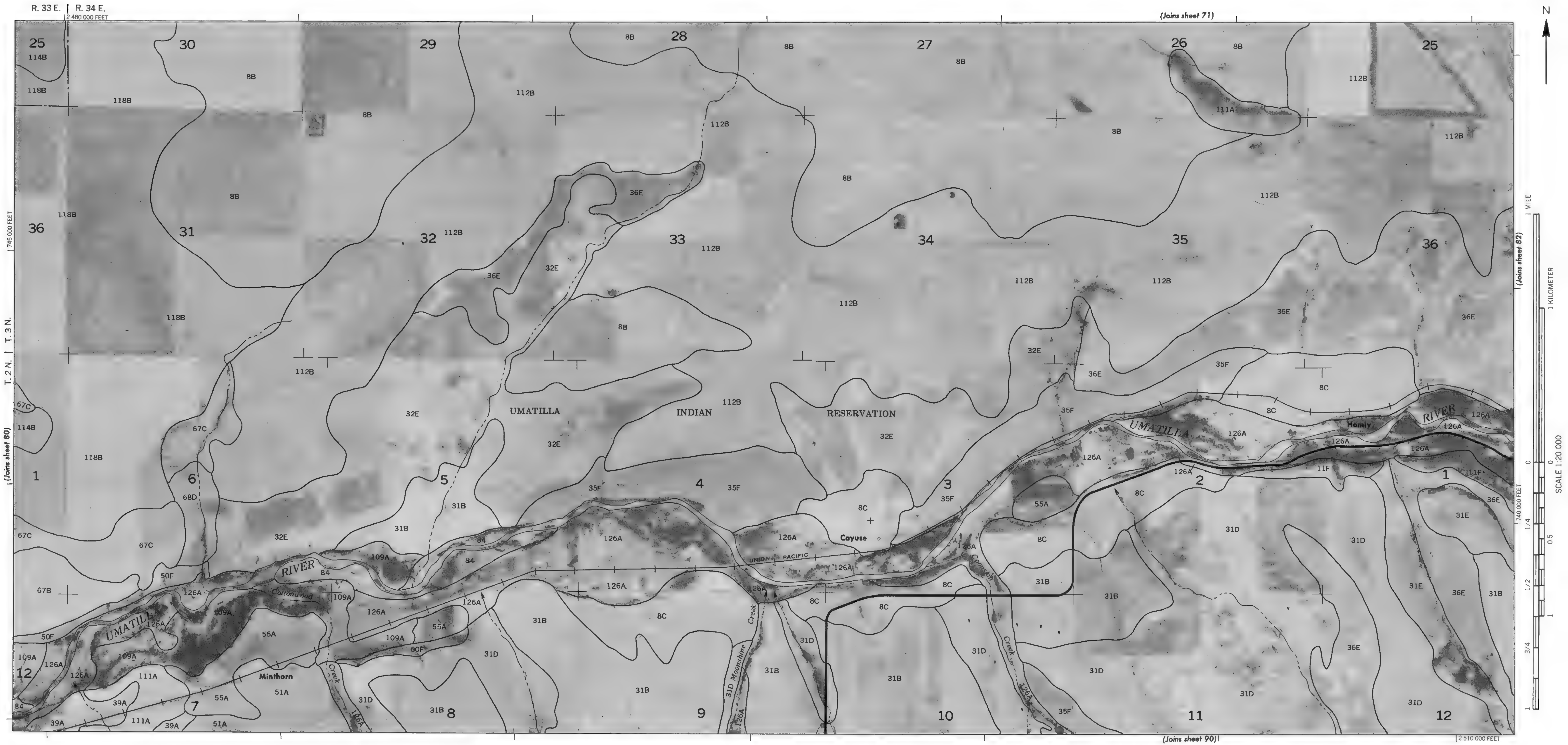

76
N
R. 28 E. R. 29 E.
(Joins sheet 66)
(Joins sheet 85)
(Joins sheet 75)
(Joins sheet 77)
T. 3 N.
T. 2 N.
2 350 000 FEET
2 320 000 FEET
745 000 FEET
735 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
UMATILLA
RIVER
UNION PACIFIC
FURNISH DITCH
Alkali
Canyon
Speare Canyon

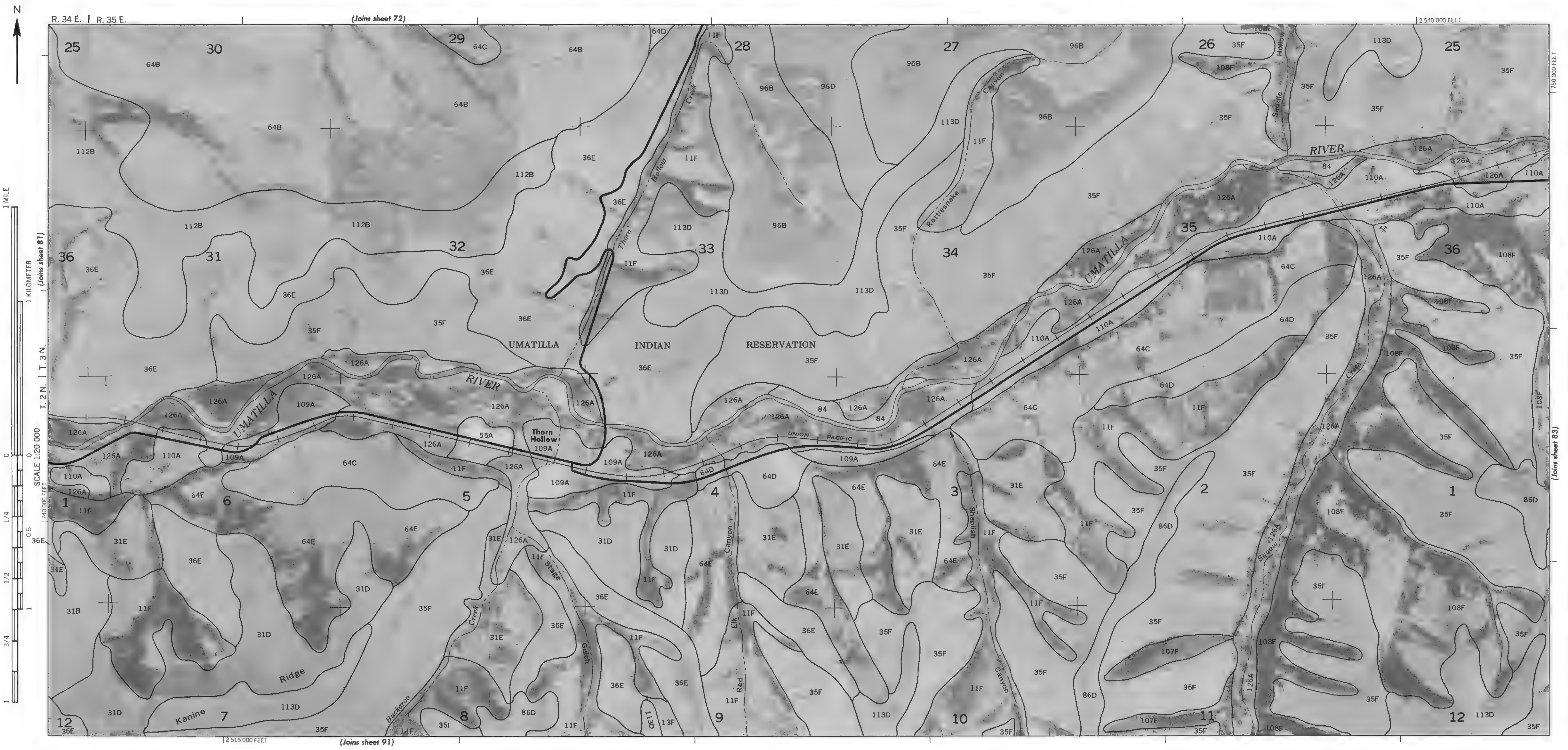

R. 29 E. | R. 30 E.
2 355 000 FEET
(Joins sheet 67)
(Joins sheet 76)
(Joins sheet 78)
(Joins sheet 86)
T. 3 N.
T. 2 N.
745 000 FEET
735 000 FEET
2 380 000 FEET
N
1 MILE
1 KILOMETER
SCALE 1:20 000
Speare Canyon
Nolin
Yoakum
UMATILLA RIVER
UNION PACIFIC
Mud Spring Can.
Horseshoe Curve
U.P.

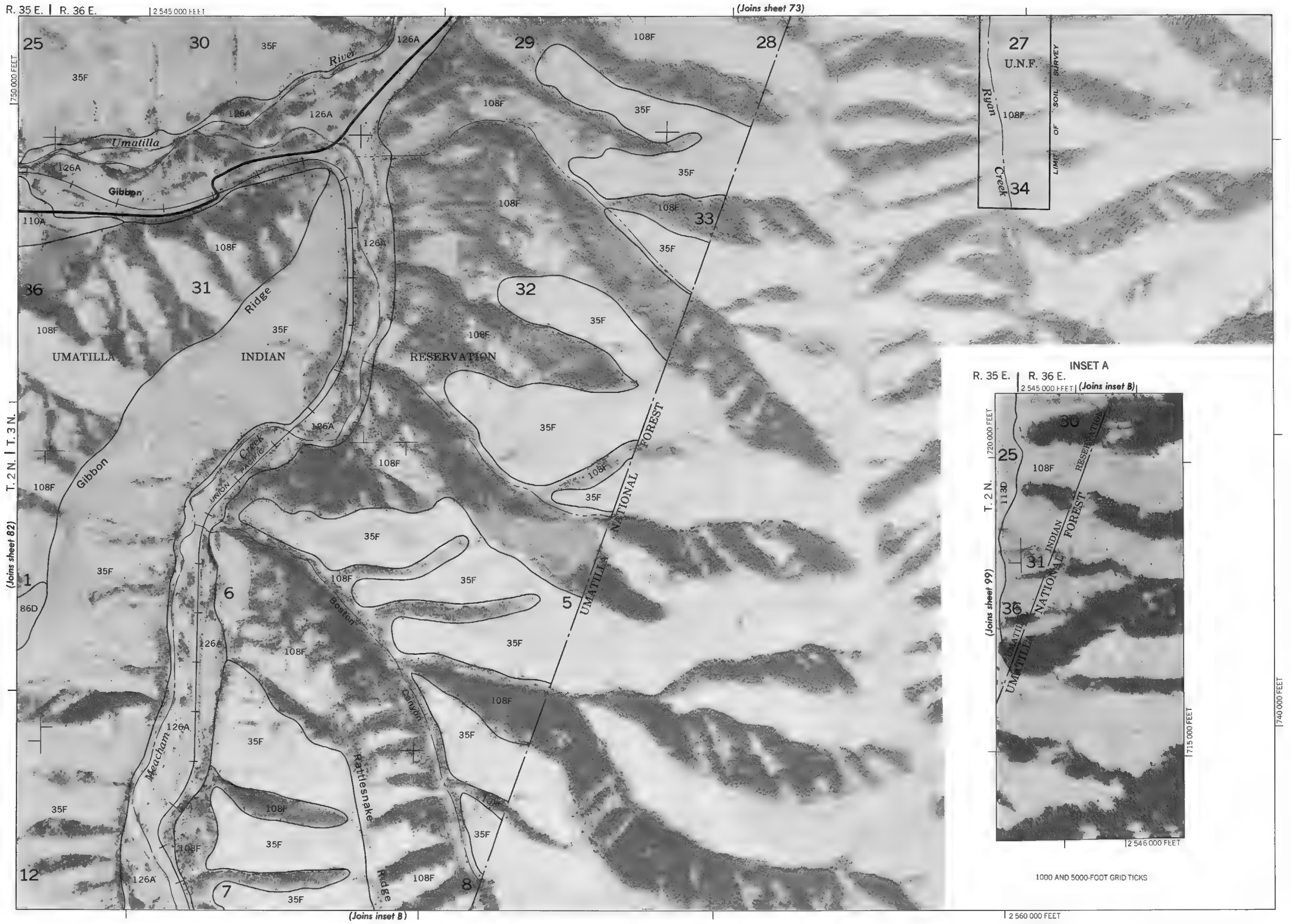

N
R. 30 E.
R. 31 E.
(Joins sheet 68)
(Joins sheet 77)
(Joins sheet 79)
(Joins sheet 87)
2 415 000 FEET
745 000 FEET
735 000 FEET
2 385 000 FEET
T. 3 N.
T. 2 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
UMATILLA
RIVER
U.P.
Rieth
Ridge
84
30
395
25
30
29
28
27
26
25
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
54C
121B
80B
54D
54B
114B
115D
6D
6C
114C
48E
82E
49F
80C
63A
126A
50F
60F
81E
115E
6B
24C

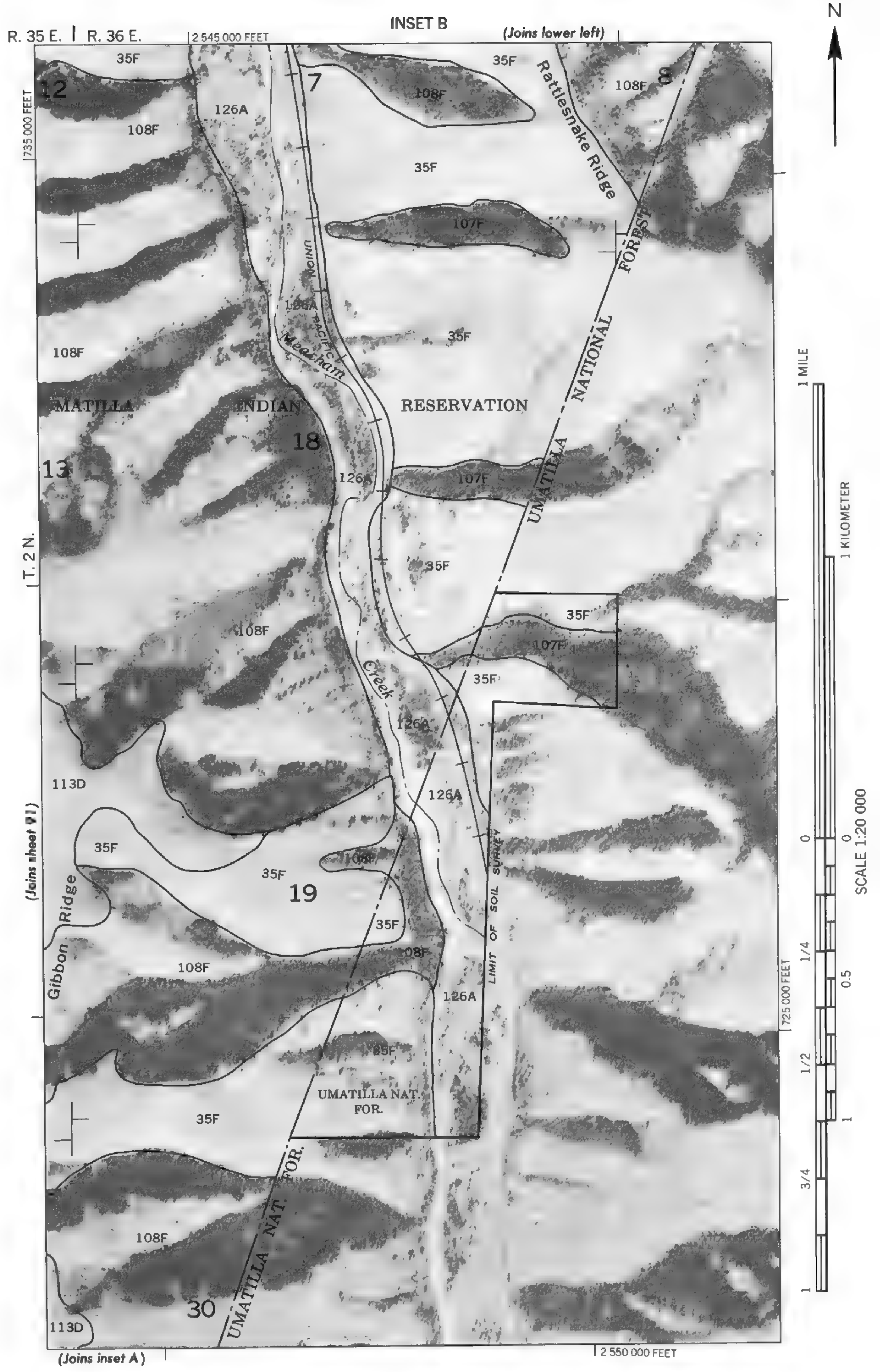

R. 31 E.
R. 32 E.
2 420 000 FEET
(Joins sheet 69)
(Joins sheet 78)
(Joins sheet 80)
(Joins sheet 88)
2 445 000 FEET
745 000 FEET
735 000 FEET
T. 3 N.
T. 2 N.
Municipal Airport
Pendair Heights
Pendair
PENDLETON
(county seat)
UMATILLA RIVER
Owen Hill
Wildhorse Creek
BURLINGTON NORTHERN
UNION PACIFIC
N
1 MILE
1 KILOMETER
SCALE 1:20 000

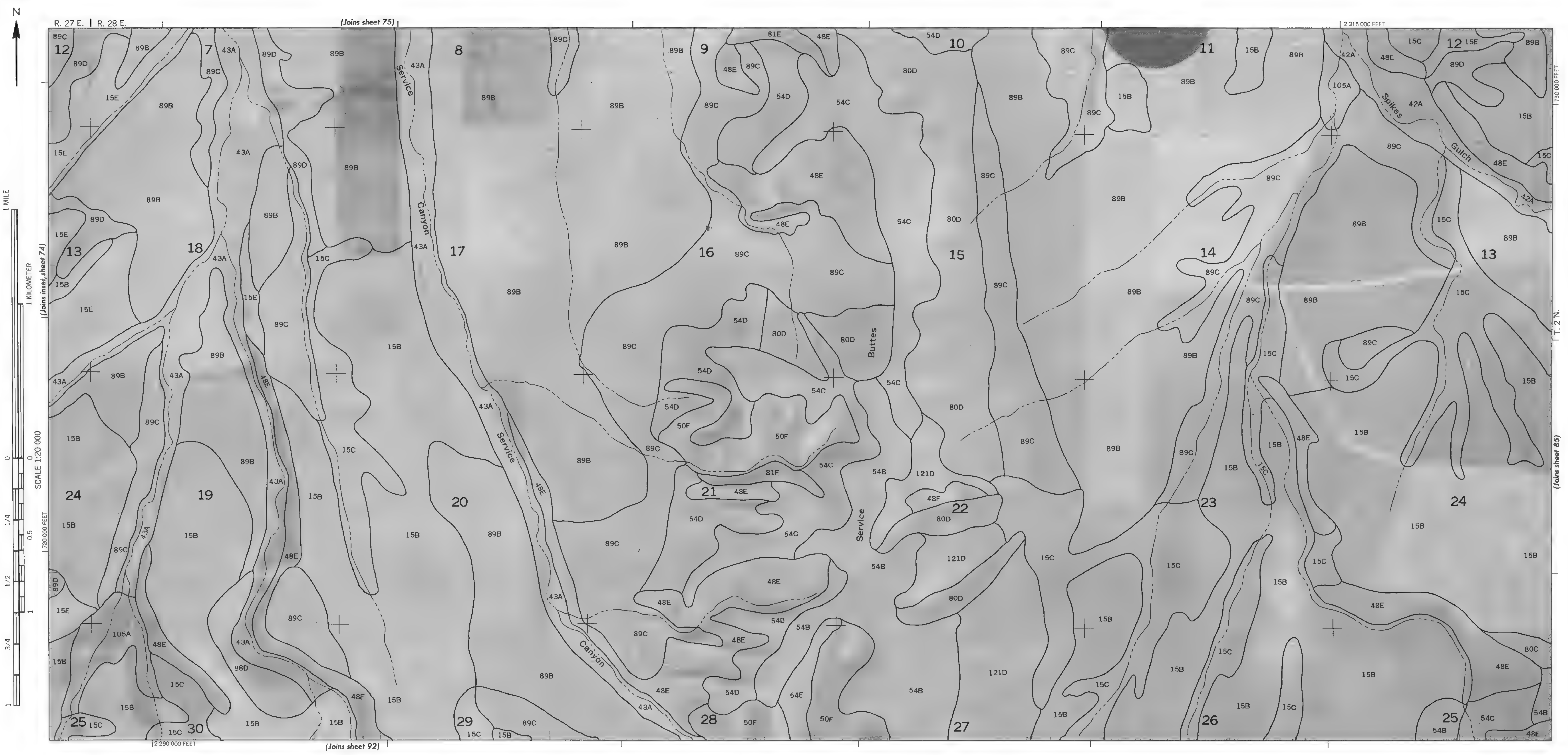

N
R. 32 E. | R. 33 E.
(Joins sheet 70)
(Joins sheet 79)
(Joins sheet 81)
(Joins sheet 89)
T. 2 N. | T. 3 N.
2 475 000 FEET
2 450 000 FEET
745 000 FEET
735 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
UMATILLA INDIAN RESERVATION
UMATILLA RIVER
Wildhorse Creek
BURLINGTON NORTHERN
UNION PACIFIC
Mission Creek
Munra
Mission

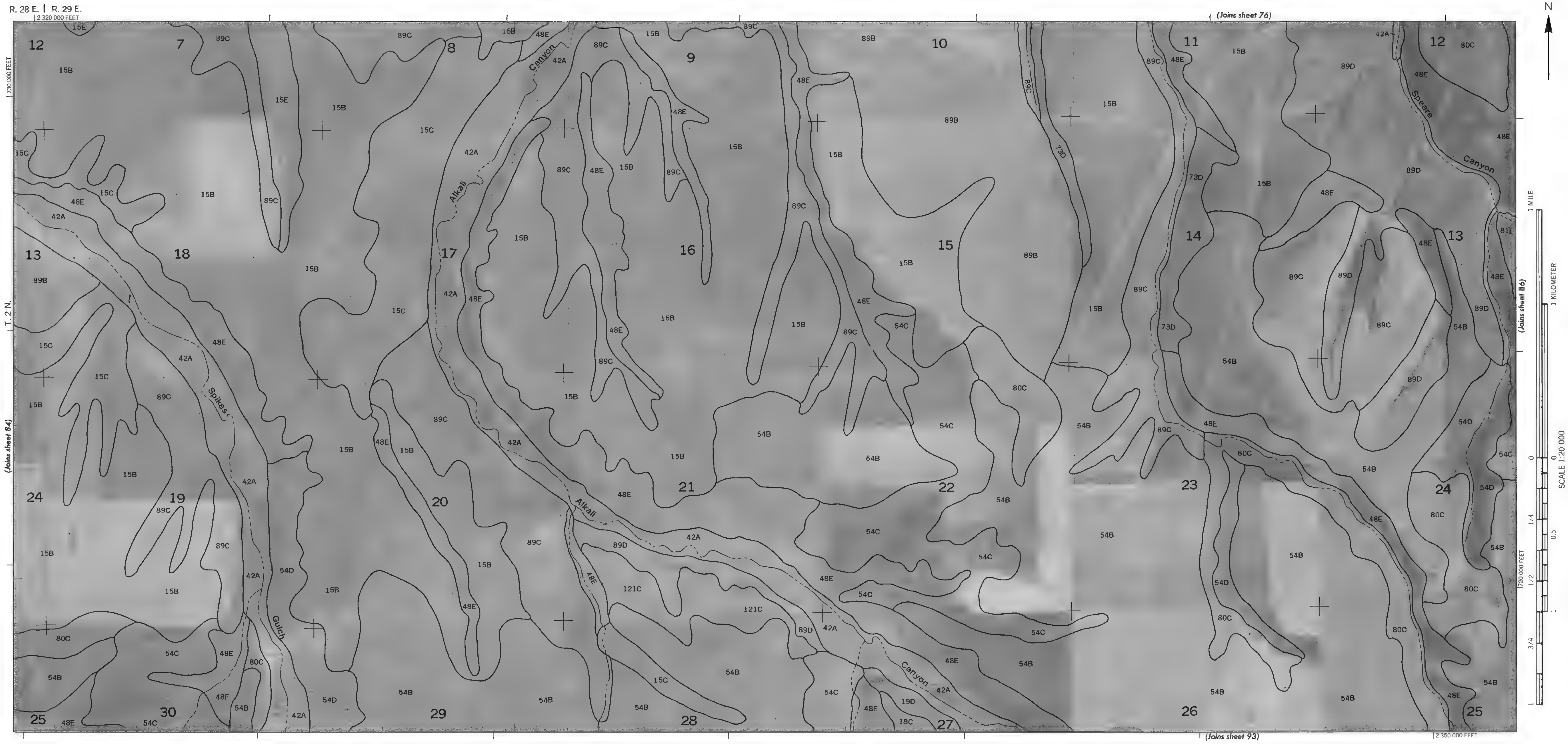

R. 33 E.
R. 34 E.
2 480 000 FEET
(Joins sheet 71)
(Joins sheet 82)
(Joins sheet 90)
(Joins sheet 80)
745 000 FEET
740 000 FEET
2 510 000 FEET
T. 3 N.
T. 2 N.
UMATILLA
INDIAN
RESERVATION
UMATILLA RIVER
UNION PACIFIC
Cayuse
Minthorn
Homly
Moonshine Creek
Coonskin Creek
Cottonwood Creek
N
SCALE 1:20 000
1 MILE
1 KILOMETER


N
R. 34 E. | R. 35 E.
(Joins sheet 72)
(Joins sheet 81)
(Joins sheet 83)
(Joins sheet 91)
2 540 000 FEET
750 000 FEET
740 000 FEET
2 515 000 FEET
T. 3 N.
T. 2 N.
SCALE 1:20 000
1 MILE
1 KILOMETER
UMATILLA INDIAN RESERVATION
UMATILLA RIVER
UNION PACIFIC
Thorn Hollow
Thorn Hollow Creek
Rattlesnake Canyon
Saddle Hollow
Squaw Creek
Shaplish Canyon
Elk Canyon
Red
Stage Gulch
Buckaroo Creek
Kanine Ridge


R. 35 E.
R. 36 E.
2 545 000 FEET
(Joins sheet 73)
750 000 FEET
T. 3 N.
T. 2 N.
(Joins sheet 82)
(Joins inset B)
2 560 000 FEET
740 000 FEET
Umatilla
River
Gibbon
Ridge
UMATILLA
INDIAN
RESERVATION
UMATILLA
NATIONAL
FOREST
U.N.F.
Ryan
Creek
LIMIT OF SOIL SURVEY
UNION PACIFIC
Meacham
Creek
Boston
Canyon
Rattlesnake
Ridge
25
30
29
28
27
34
33
31
32
36
1
6
5
12
7
8
35F
108F
126A
110A
86D
INSET A
R. 35 E.
R. 36 E.
2 545 000 FEET
(Joins inset B)
720 000 FEET
715 000 FEET
2 546 000 FEET
T. 2 N.
(Joins sheet 99)
113D
UMATILLA
NATIONAL
FOREST
INDIAN
RESERVATION
1000 AND 5000-FOOT GRID TICKS

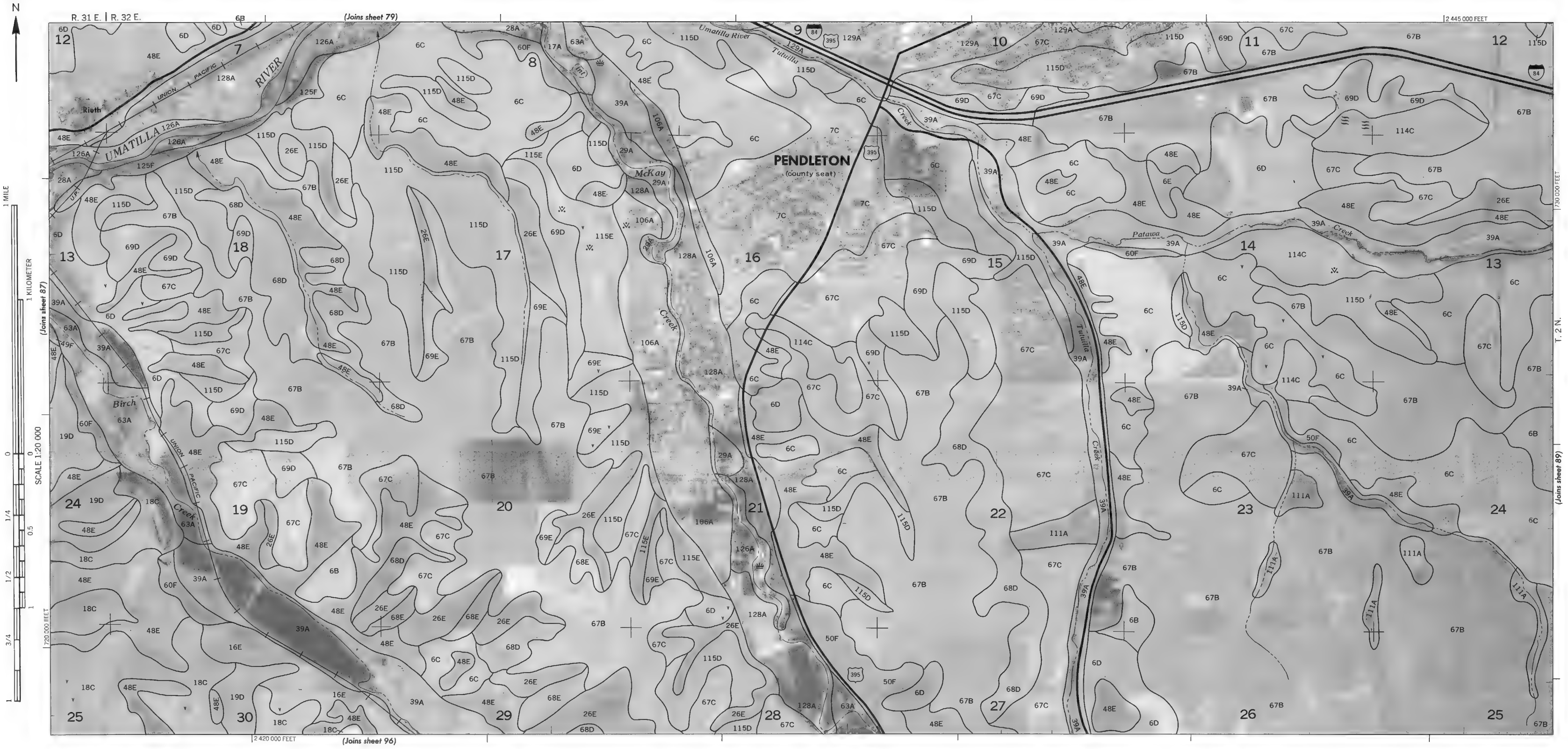

INSET B
R. 35 E.
R. 36 E.
2 545 000 FEET
(Joins lower left)
735 000 FEET
725 000 FEET
T. 2 N.
(Joins sheet 91)
(Joins inset A)
2 550 000 FEET
Rattlesnake Ridge
UMATILLA
INDIAN
RESERVATION
UMATILLA
NATIONAL
FOREST
UNION PACIFIC
Meacham
Creek
LIMIT OF SOIL SURVEY
Gibbon
Ridge
UMATILLA NAT. FOR.
UMATILLA NAT. FOR.
12
7
8
13
18
19
30
35F
107F
108F
113D
126A
N
1 MILE
1 KILOMETER
SCALE 1:20 000

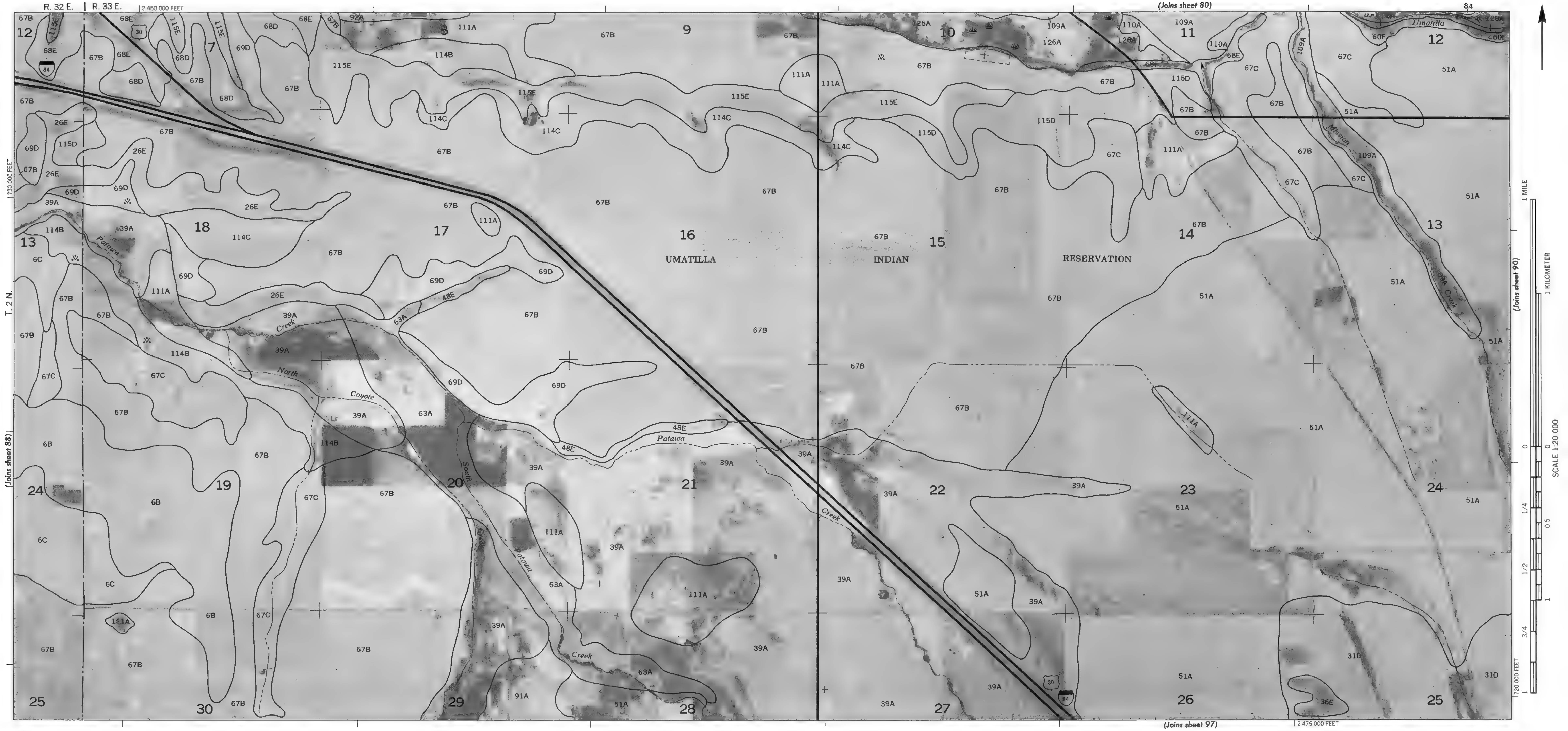

N
R. 27 E.
R. 28 E.
(Joins sheet 75)
(Joins inset, sheet 74)
(Joins sheet 85)
(Joins sheet 92)
2 315 000 FEET
730 000 FEET
720 000 FEET
2 290 000 FEET
T. 2 N.
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Service Canyon
Service
Buttes
Spikes Gulch
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
15B
15C
15E
42A
43A
48E
50F
54B
54C
54D
54E
80C
80D
81E
88D
89B
89C
89D
105A
121D

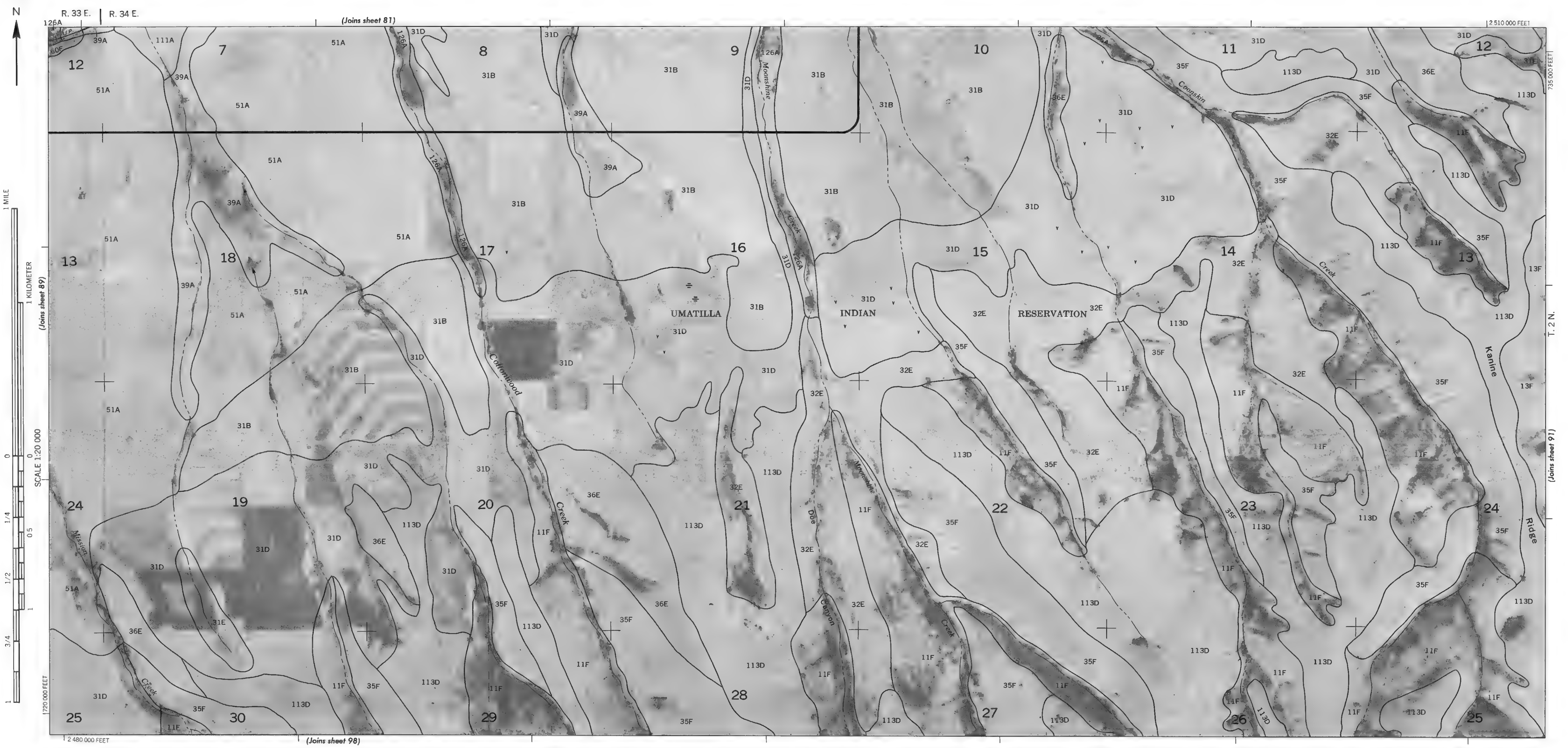

85
N
R. 28 E. | R. 29 E.
2 320 000 FEET
730 000 FEET
T. 2 N.
(Joins sheet 76)
(Joins sheet 84)
(Joins sheet 86)
(Joins sheet 93)
720 000 FEET
2 350 000 FEET
Alkali
Canyon
Alkali
Canyon
Spikes
Gulch
Speare
Canyon
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
12
7
8
9
10
11
12
13
18
17
16
15
14
13
24
19
20
21
22
23
24
25
30
29
28
27
26
25

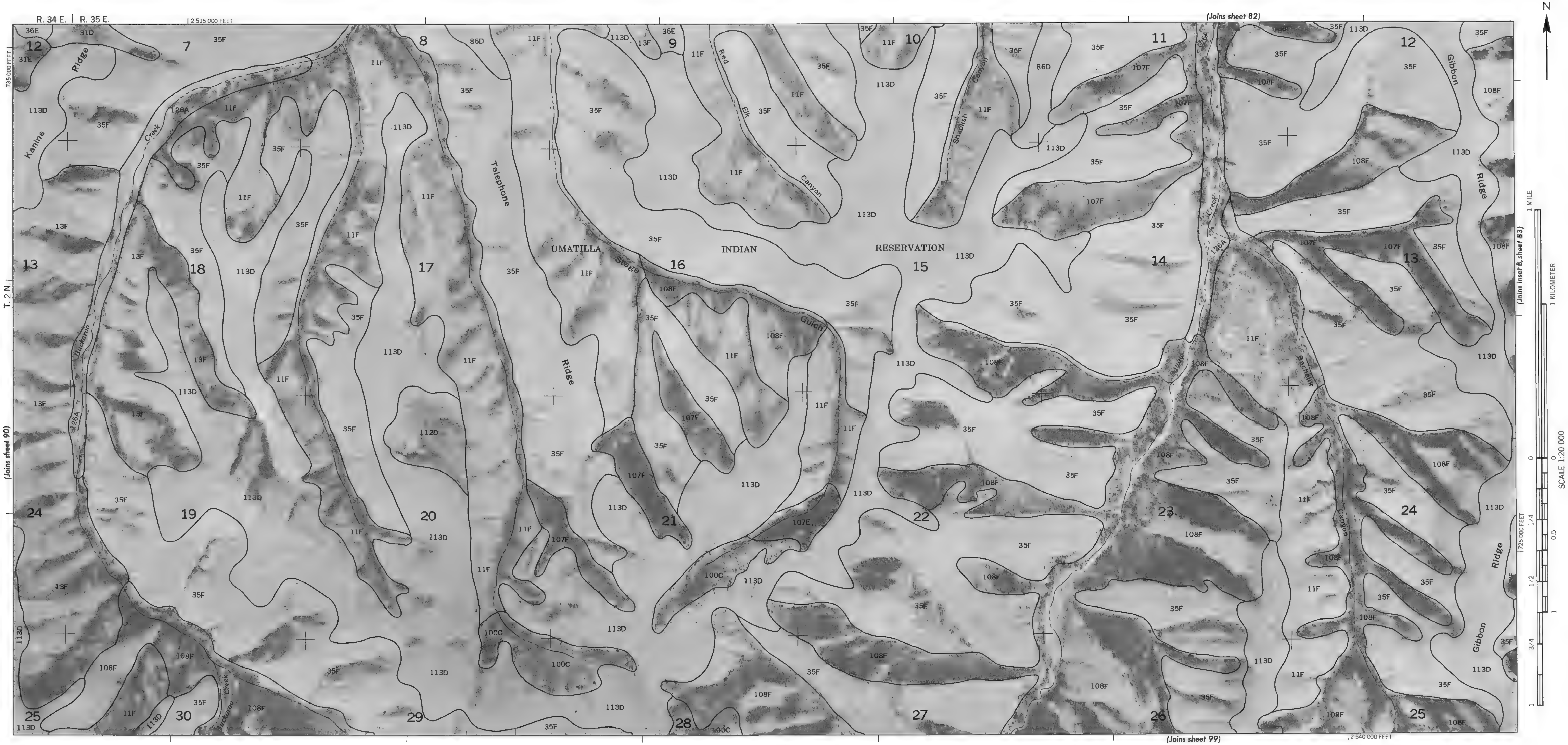

N
R. 29 E. | R. 30 E.
(Joins sheet 77)
(Joins sheet 85)
(Joins sheet 87)
(Joins sheet 94)
T. 2 N.
2 380 000 FEET
730 000 FEET
720 000 FEET
2 355 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
Umatilla River
UNION PACIFIC
Mud
Spring
Canyon
Speare
Canyon
12
7
8
9
10
11
12
13
18
17
16
15
14
13
24
19
20
21
22
23
24
25
30
29
28
27
26
25
54B
54C
54D
48E
49F
50F
80B
80C
80D
81E
43A
16C
16D
18B
18C
19D
21D
28A
125F

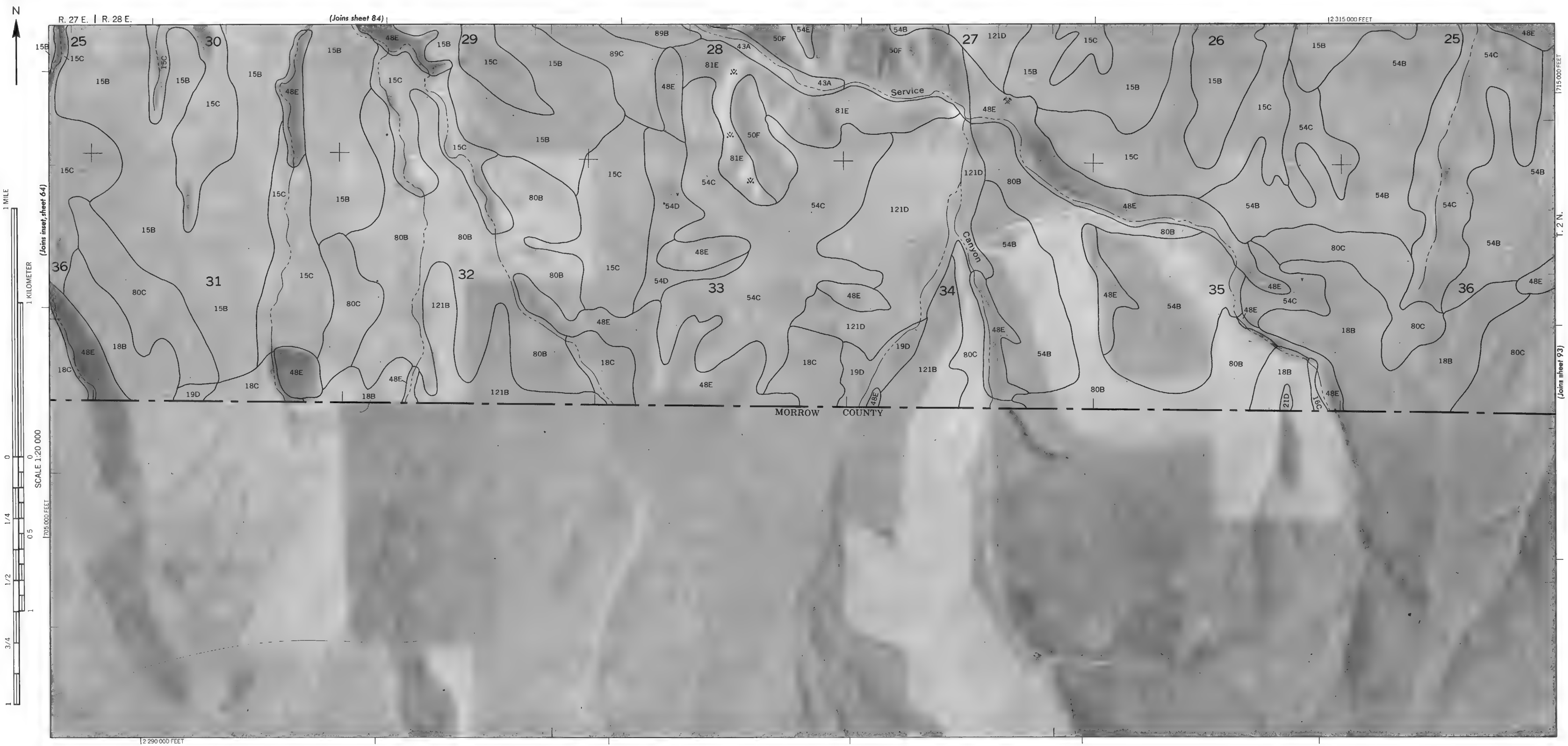

87
N
R. 30 E. | R. 31 E.
2 385 000 FEET
(Joins sheet 78)
(Joins sheet 86)
(Joins sheet 88)
(Joins sheet 95)
2 415 000 FEET
730 000 FEET
720 000 FEET
T. 2 N.
UMATILLA
RIVER
UNION PACIFIC
Barnhart
Birch Creek
Coombs
Canyon
1 MILE
1 KILOMETER
SCALE 1:20 000

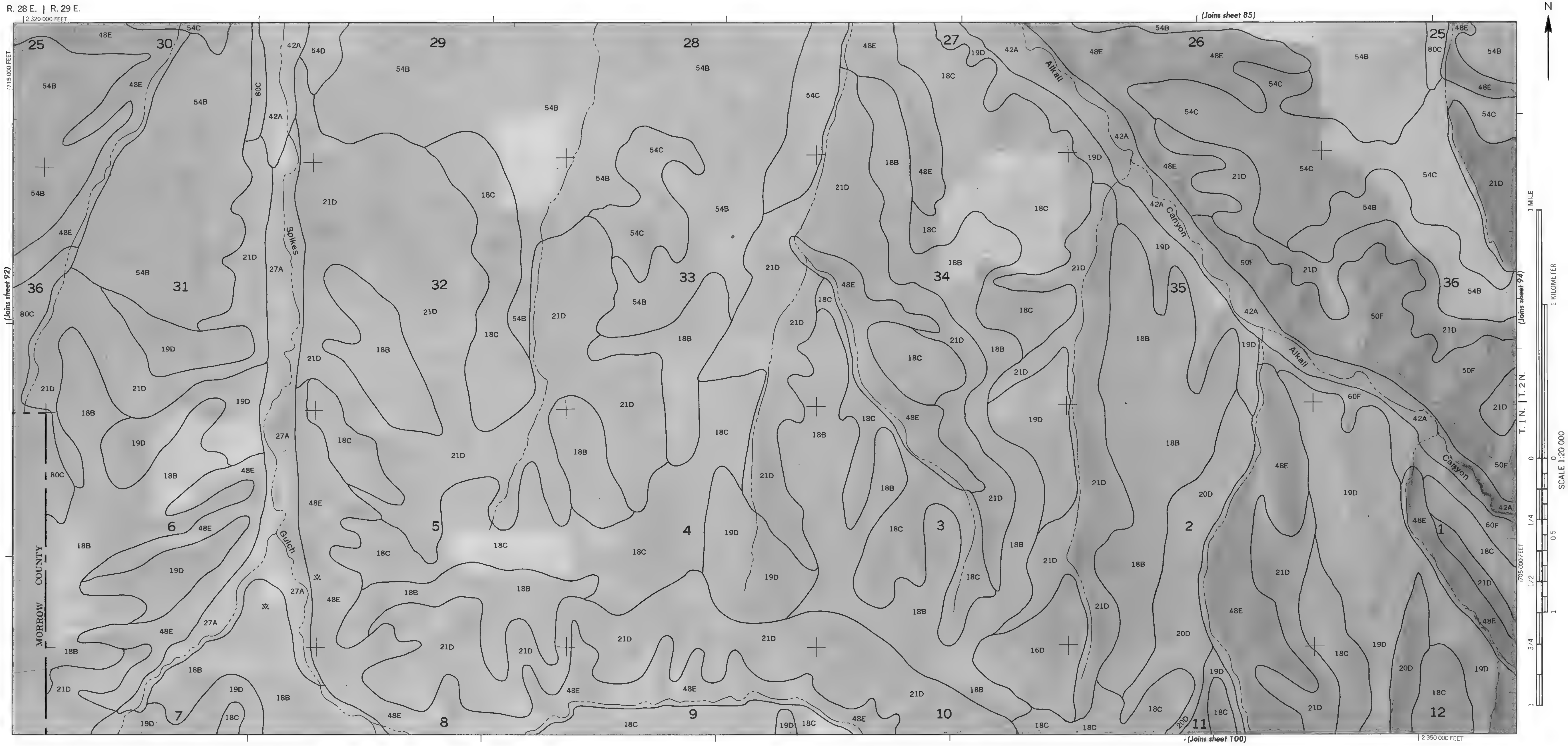

N
R. 31 E. | R. 32 E.
(Joins sheet 79)
(Joins sheet 96)
(Joins sheet 87)
(Joins sheet 89)
2 445 000 FEET
2 420 000 FEET
730 000 FEET
720 000 FEET
T. 2 N.
PENDLETON
(county seat)
UMATILLA RIVER
Umatilla River
Rieth
UNION PACIFIC
McKay Creek
Birch Creek
Tutuilla Creek
Patawa Creek
1 MILE
1 KILOMETER
SCALE 1:20 000


R. 32 E.
R. 33 E.
2 450 000 FEET
(Joins sheet 80)
(Joins sheet 88)
(Joins sheet 90)
(Joins sheet 97)
T. 2 N.
730 000 FEET
720 000 FEET
2 475 000 FEET
UMATILLA
INDIAN
RESERVATION
Patawa
North
Coyote
Creek
South
Mission
Umatilla
N
1 MILE
1 KILOMETER
SCALE 1:20 000

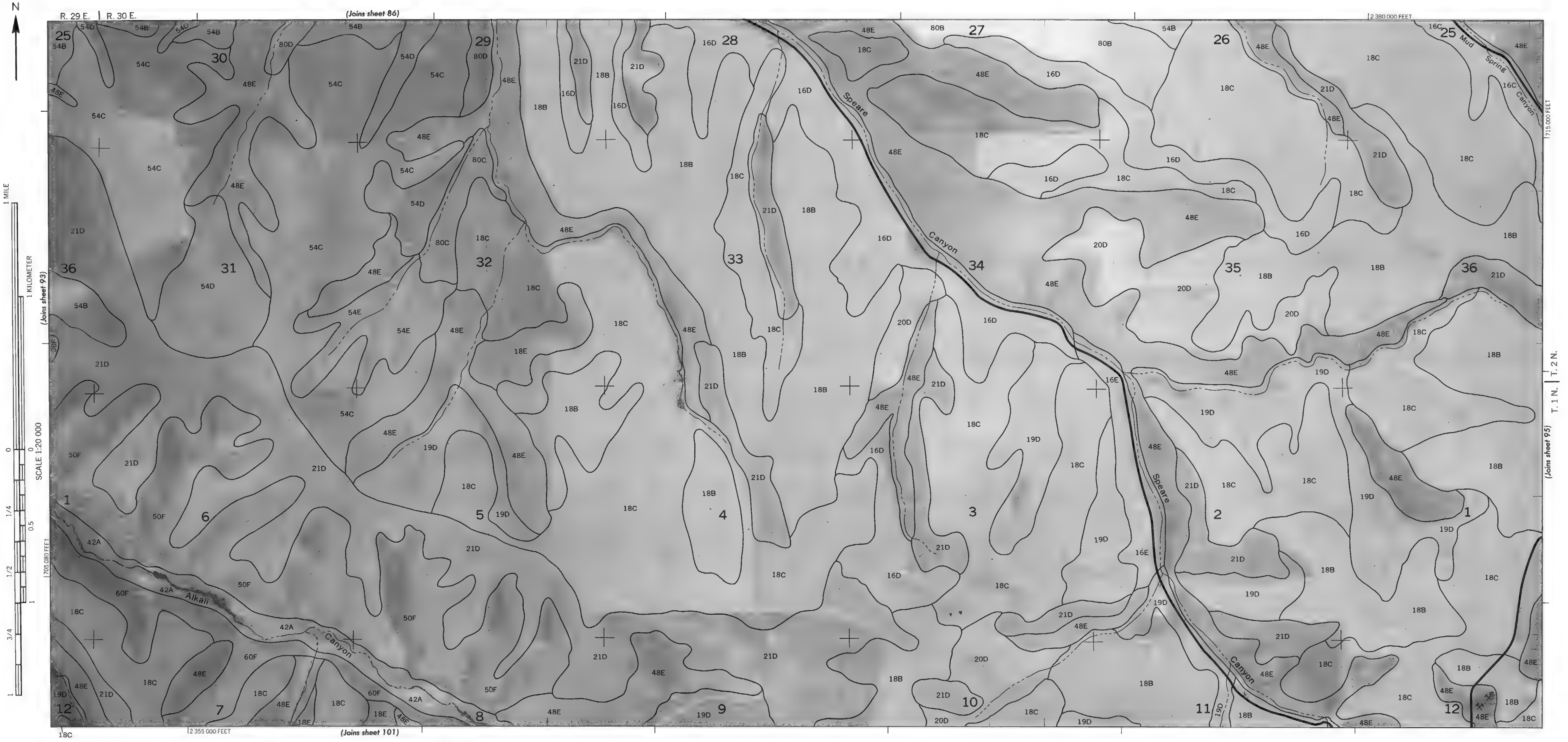

N
R. 33 E.
R. 34 E.
(Joins sheet 81)
(Joins sheet 89)
(Joins sheet 91)
(Joins sheet 98)
2 510 000 FEET
735 000 FEET
720 000 FEET
2 480 000 FEET
T. 2 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
UMATILLA
INDIAN
RESERVATION
Moonshine
Creek
Coonskin
Cottonwood
Mission
Doe
Canyon
Kanine
Ridge
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
11F
13F
31B
31D
31E
32E
35F
36E
39A
51A
60F
111A
113D
126A

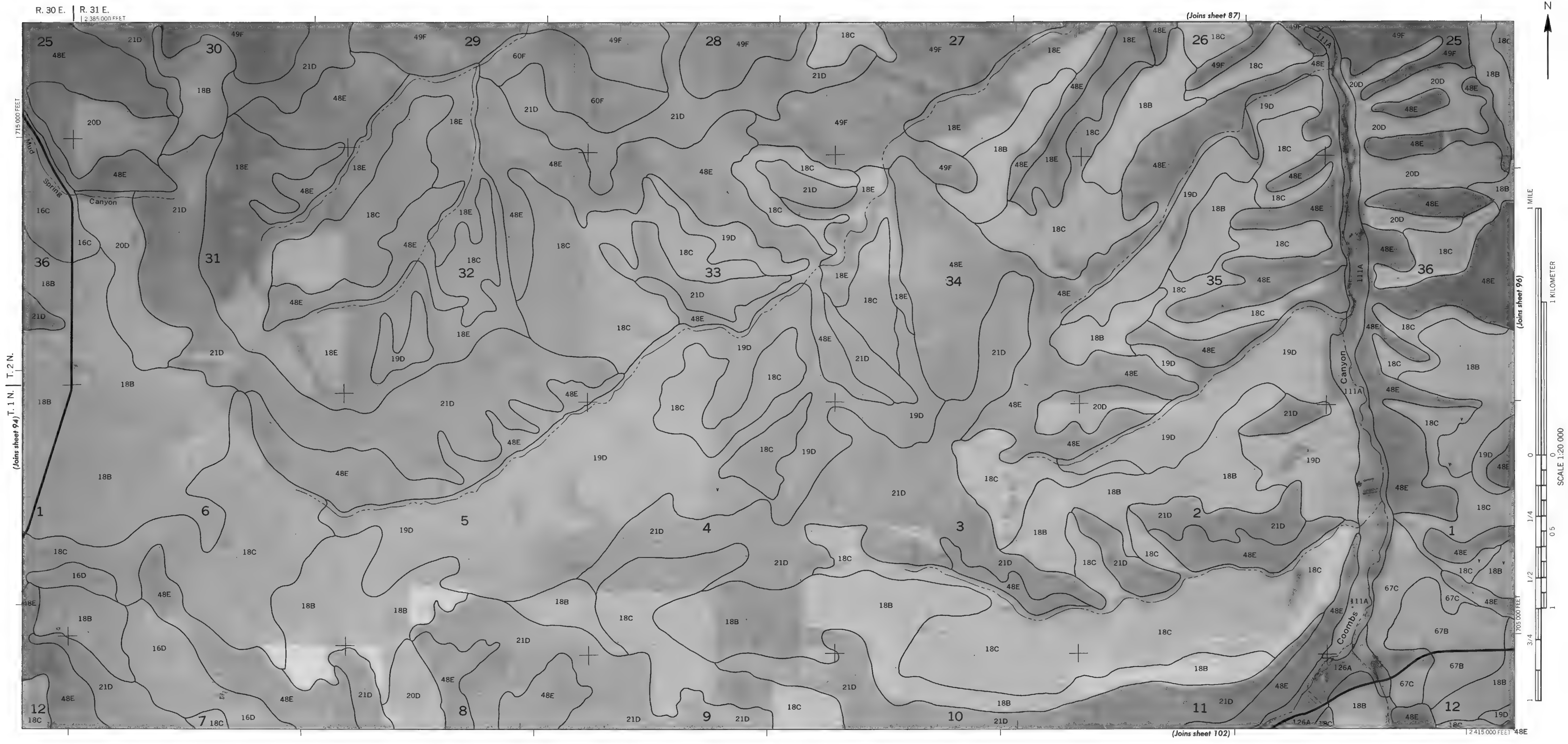

91
N
R. 34 E. | R. 35 E.
2 515 000 FEET
(Joins sheet 82)
(Joins sheet 90)
(Joins sheet 99)
(Joins inset B, sheet 83)
2 540 000 FEET
725 000 FEET
735 000 FEET
T. 2 N.
UMATILLA INDIAN RESERVATION
Kanine Ridge
Buckaroo Creek
Telephone Ridge
Red Elk Canyon
Shaplish Canyon
Stage Gulch
Gibbon Ridge
Bachelor Canyon
1 MILE
1 KILOMETER
SCALE 1:20 000

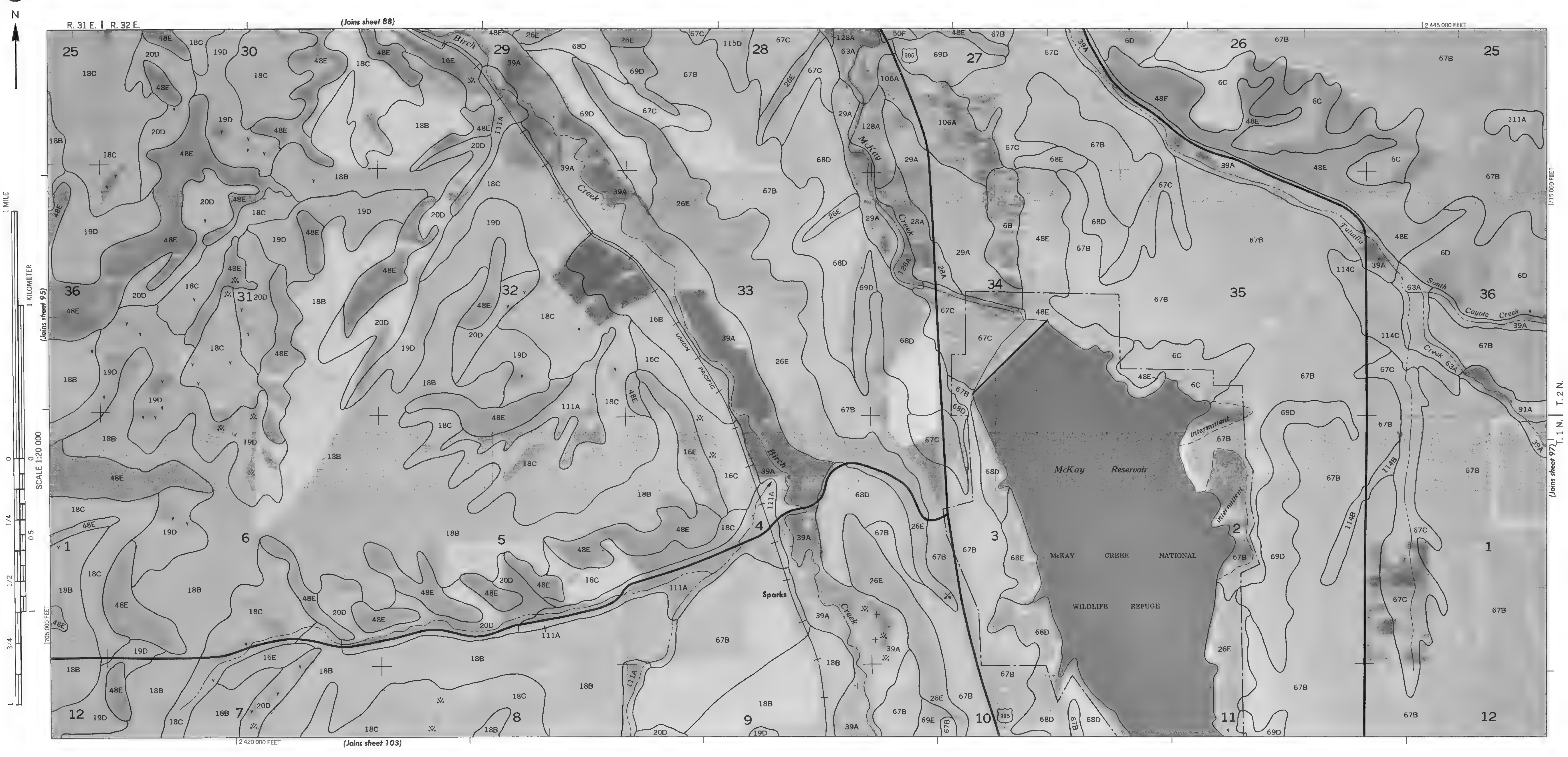

N
R. 27 E. | R. 28 E.
(Joins sheet 84)
(Joins inset, sheet 64)
(Joins sheet 93)
T. 2 N.
2 315 000 FEET
715 000 FEET
705 000 FEET
2 290 000 FEET
Service
Canyon
MORROW COUNTY
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
15B
15C
18B
18C
19D
21D
43A
48E
50F
54B
54C
54D
54E
80B
80C
81E
89B
89C
121B
121D
25
26
27
28
29
30
31
32
33
34
35
36

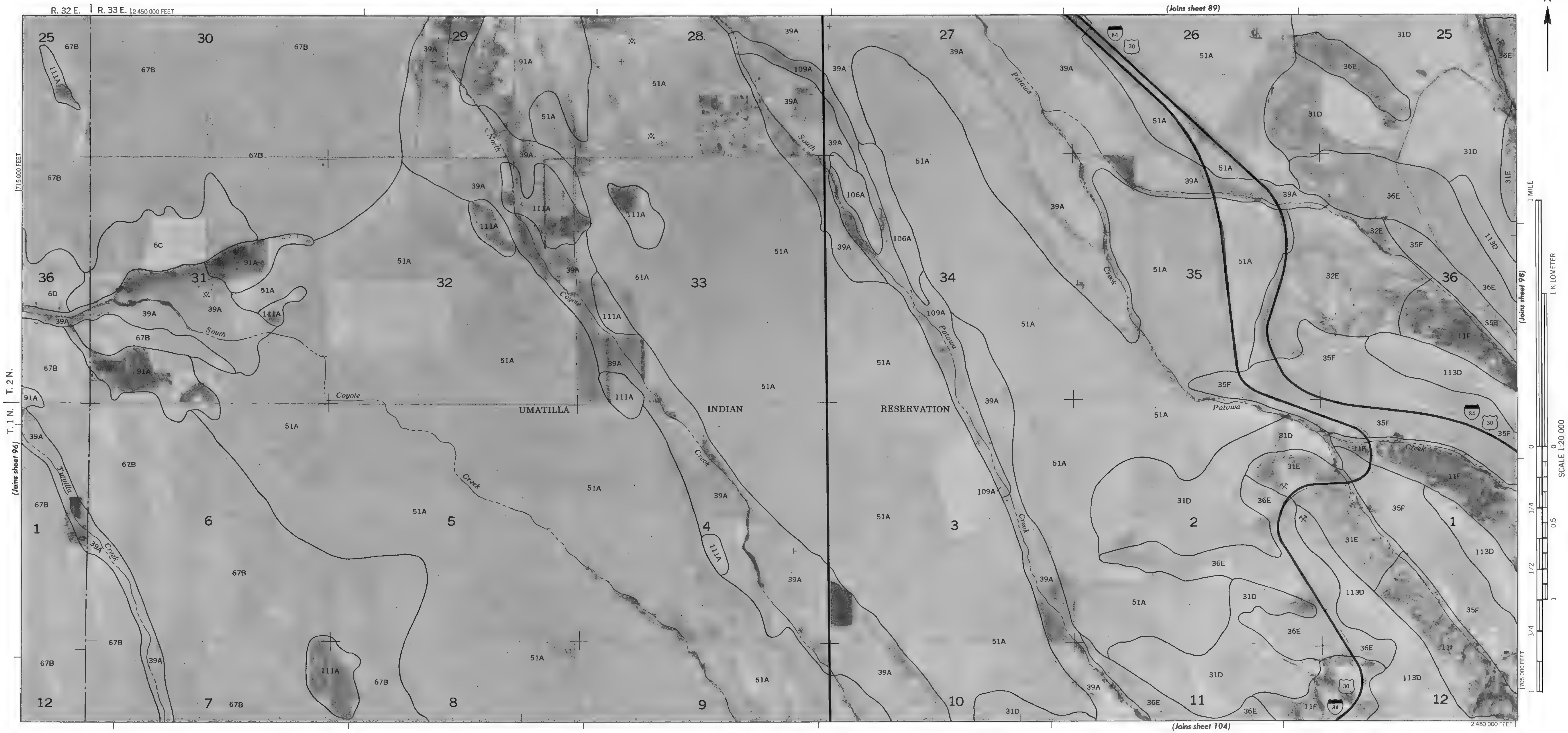

R. 28 E. | R. 29 E.
2 320 000 FEET
(Joins sheet 85)
715 000 FEET
(Joins sheet 92)
(Joins sheet 94)
(Joins sheet 100)
2 350 000 FEET
705 000 FEET
T. 1 N. | T. 2 N.
MORROW COUNTY
Spikes
Gulch
Alkali
Canyon
N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
25
30
29
28
27
26
36
31
32
33
34
35
6
5
4
3
2
1
7
8
9
10
11
12
48E
54C
42A
54D
54B
80C
21D
27A
18B
19D
18C
21D
50F
60F
20D
16D
19D
20D

UMATILLA COUNTY AREA, OREGON — SHEET NUMBER 94



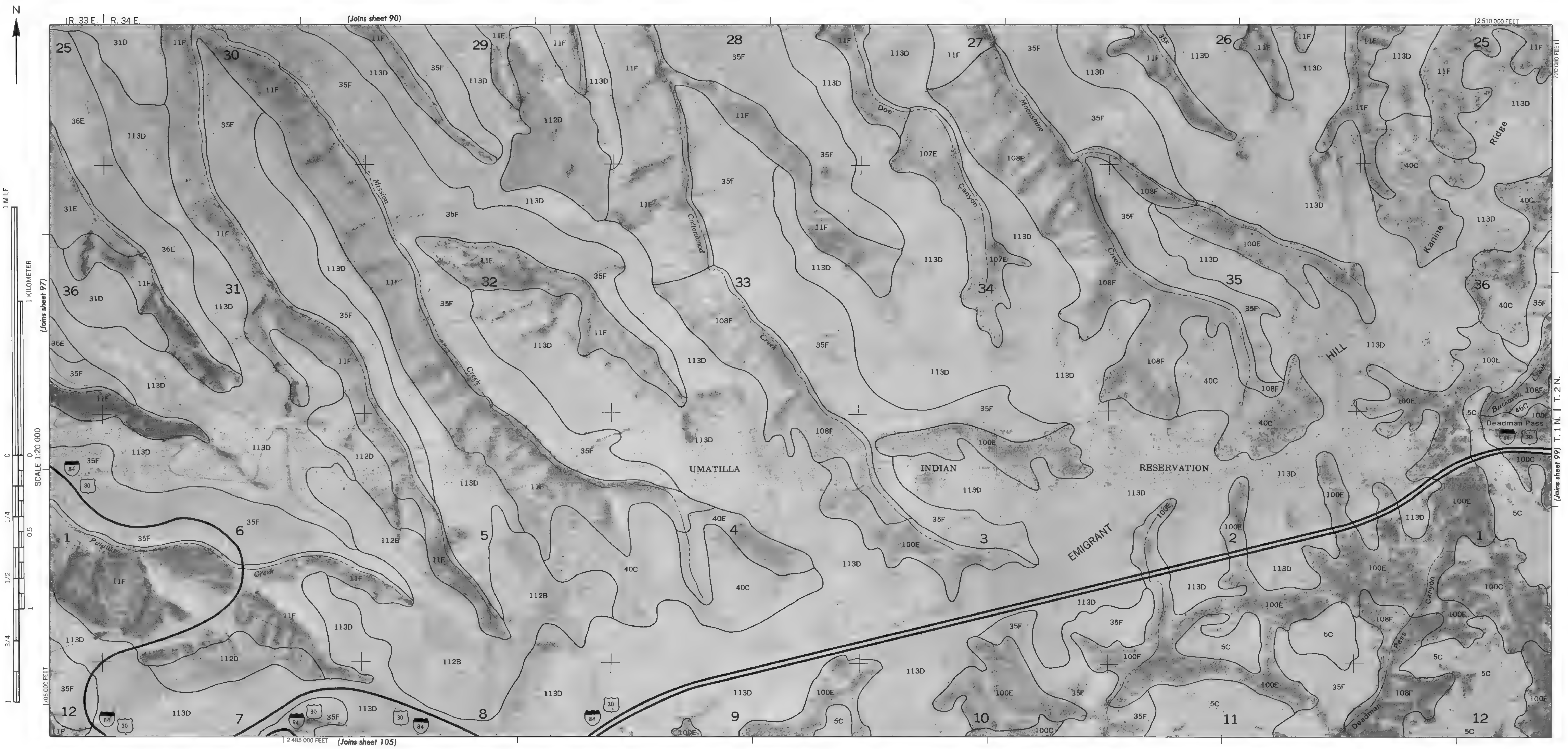

R. 30 E.
R. 31 E.
2 385 000 FEET
(Joins sheet 87)
(Joins sheet 94)
(Joins sheet 96)
(Joins sheet 102)
715 000 FEET
705 000 FEET
2 415 000 FEET
T. 2 N.
T. 1 N.
N
Spring
Canyon
Canyon
Coombs
1 MILE
1 KILOMETER
SCALE 1:20 000
25
30
29
28
27
26
25
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12

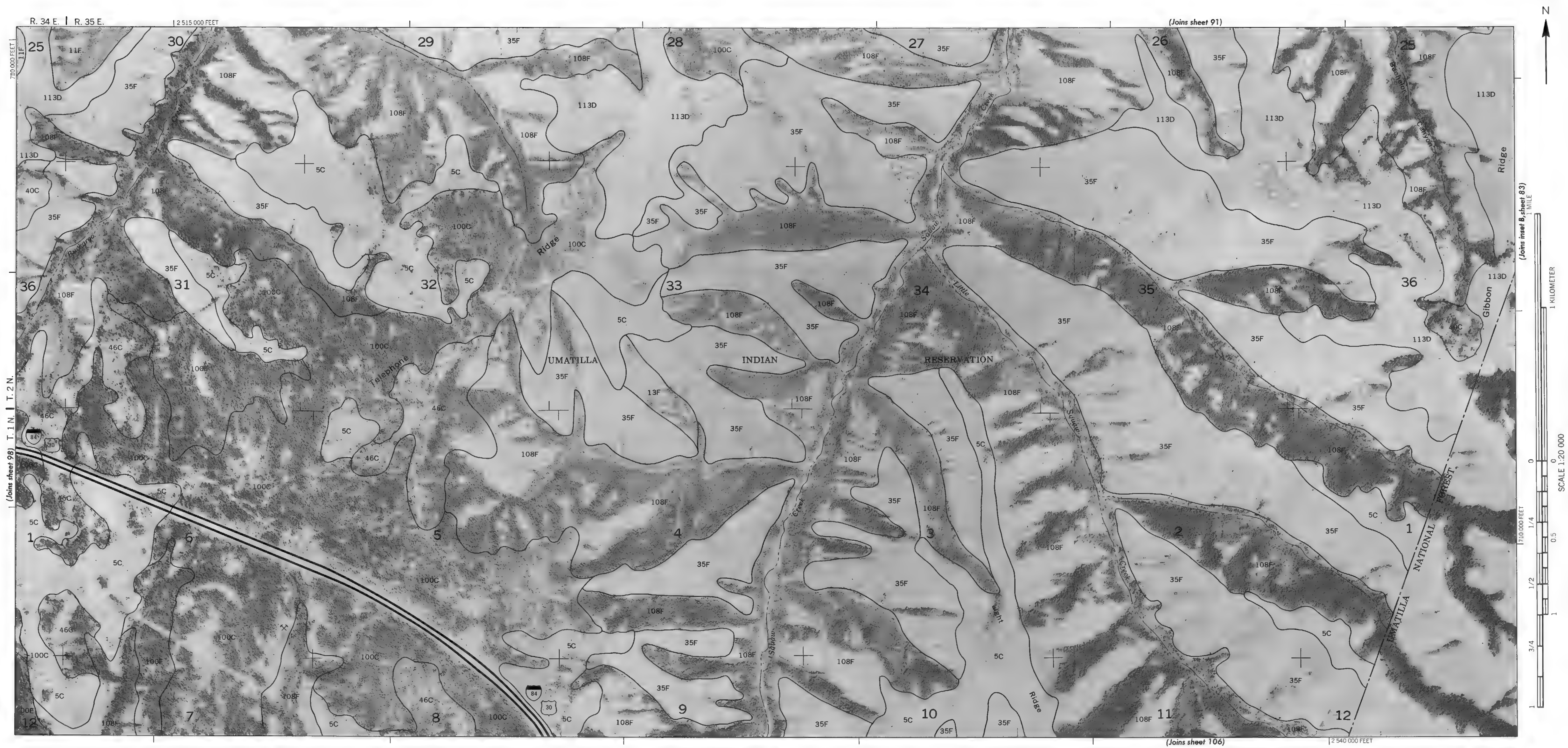

96
N
R. 31 E. | R. 32 E.
(Joins sheet 88)
(Joins sheet 95)
(Joins sheet 97)
(Joins sheet 103)
T. 2 N.
T. 1 N.
2 445 000 FEET
2 420 000 FEET
715 000 FEET
705 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
Birch Creek
McKay Creek
UNION PACIFIC
Sparks
McKay Reservoir
McKAY CREEK NATIONAL WILDLIFE REFUGE
intermittent
Tutuilla
South Coyote Creek
395

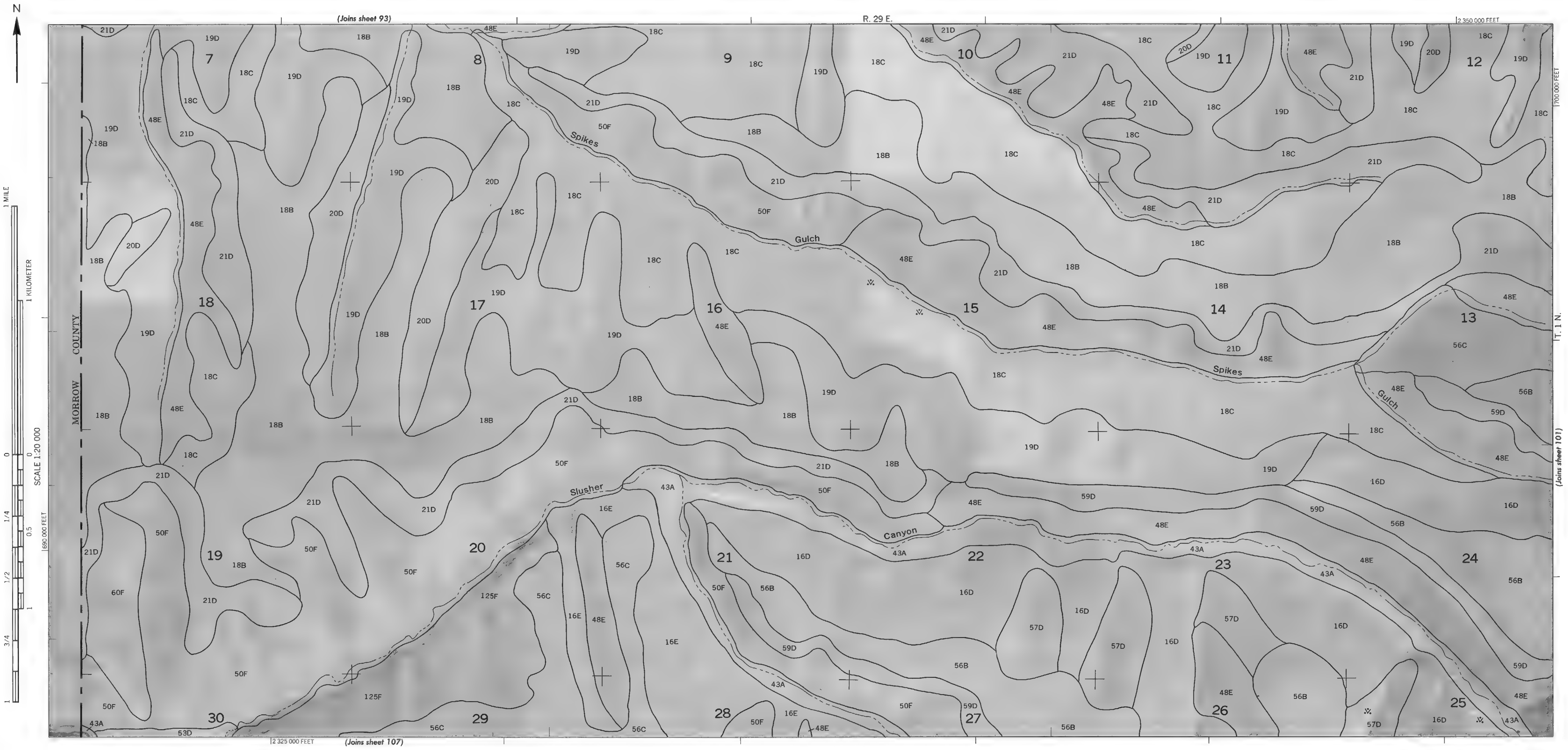


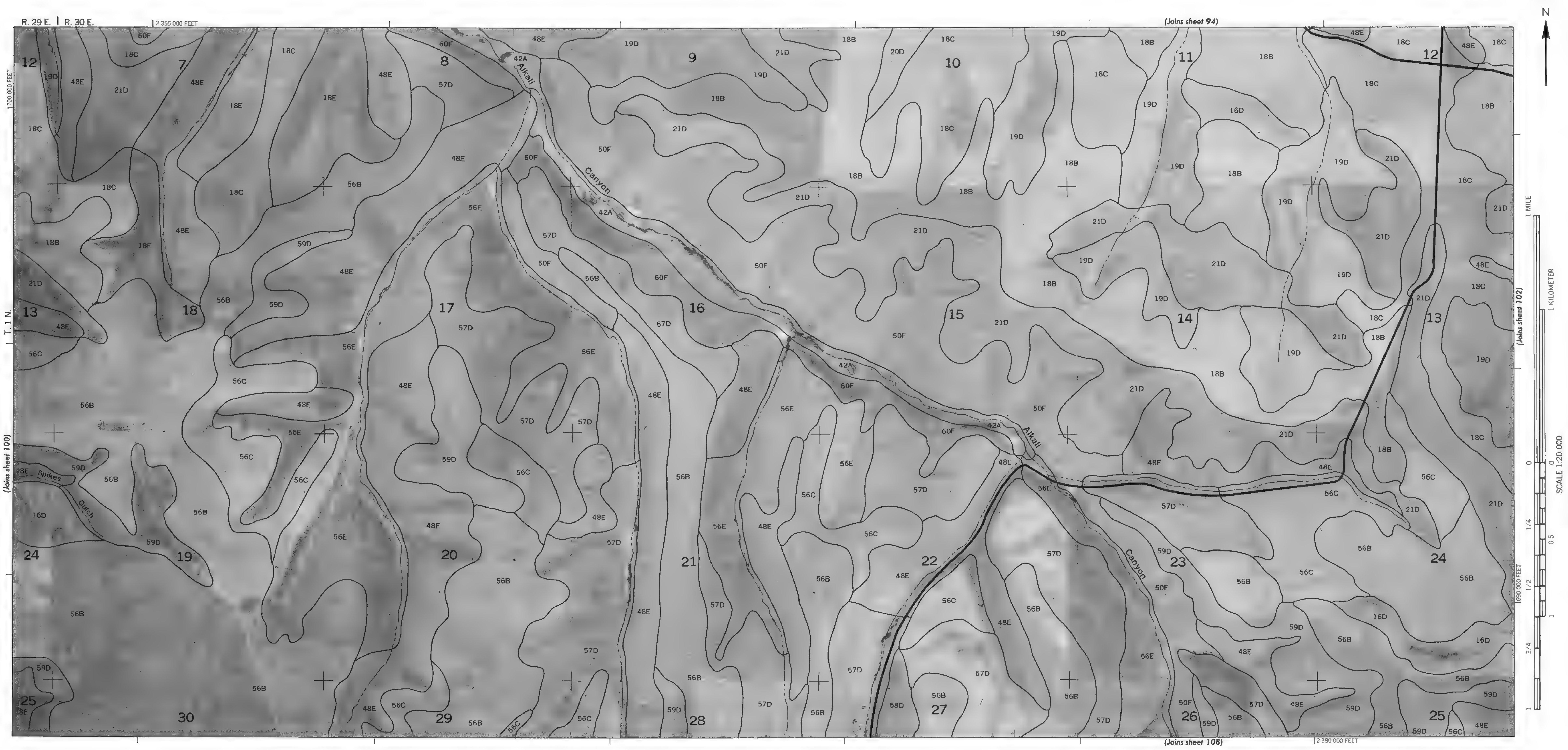
(Joins sheet 89)
(Joins sheet 104)
(Joins sheet 96)
(Joins sheet 98)
R. 32 E.
R. 33 E.
2 450 000 FEET
2 480 000 FEET
715 000 FEET
705 000 FEET
T. 2 N.
T. 1 N.
N
UMATILLA
INDIAN
RESERVATION
South
North
Coyote
Creek
Patawa
Creek
Tutuilla
Creek
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
84
30
25
30
29
28
27
26
25
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12
67B
111A
6C
6D
39A
91A
51A
109A
106A
31D
31E
36E
32E
35F
11F
113D

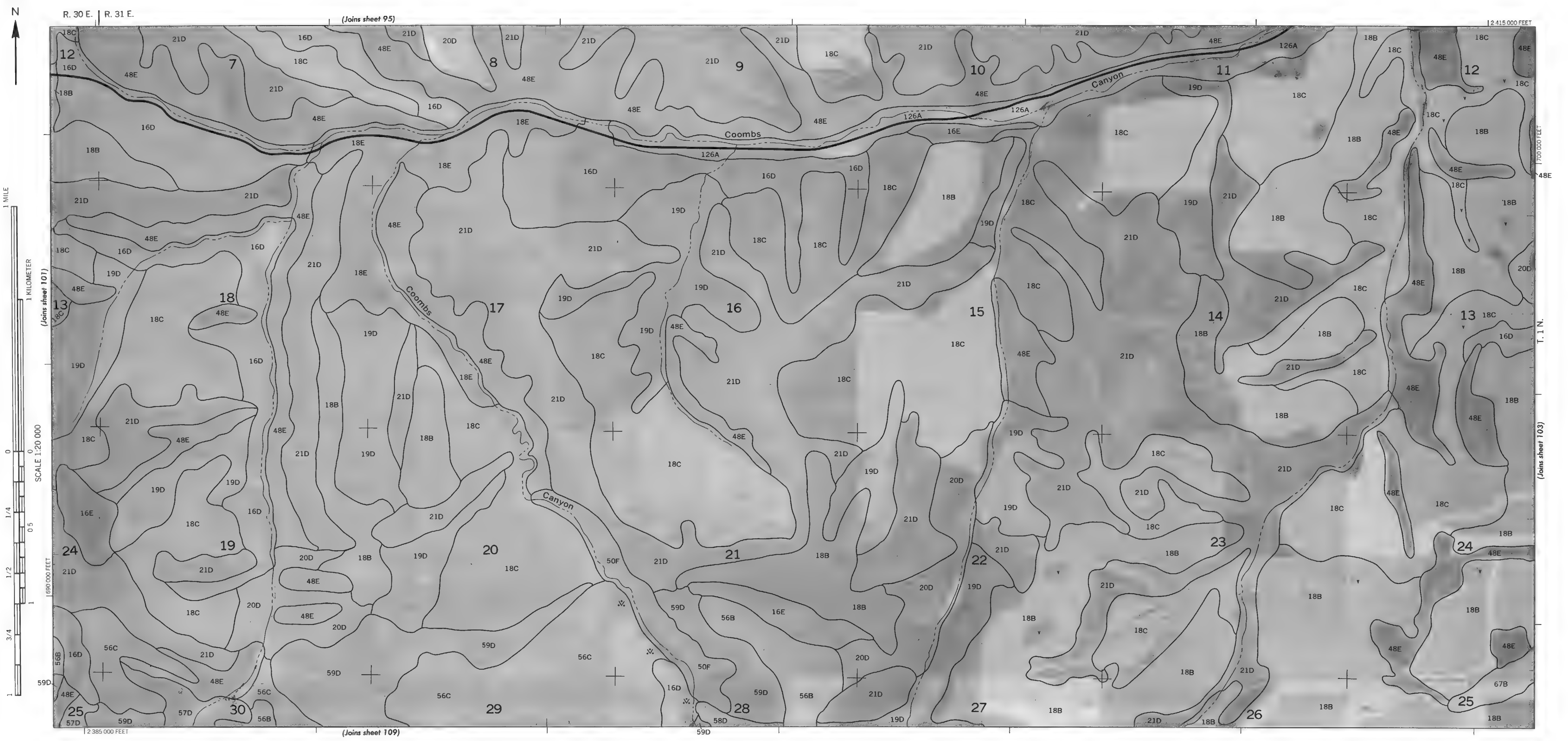
UMATILLA COUNTY AREA, OREGON — SHEET NUMBER 98

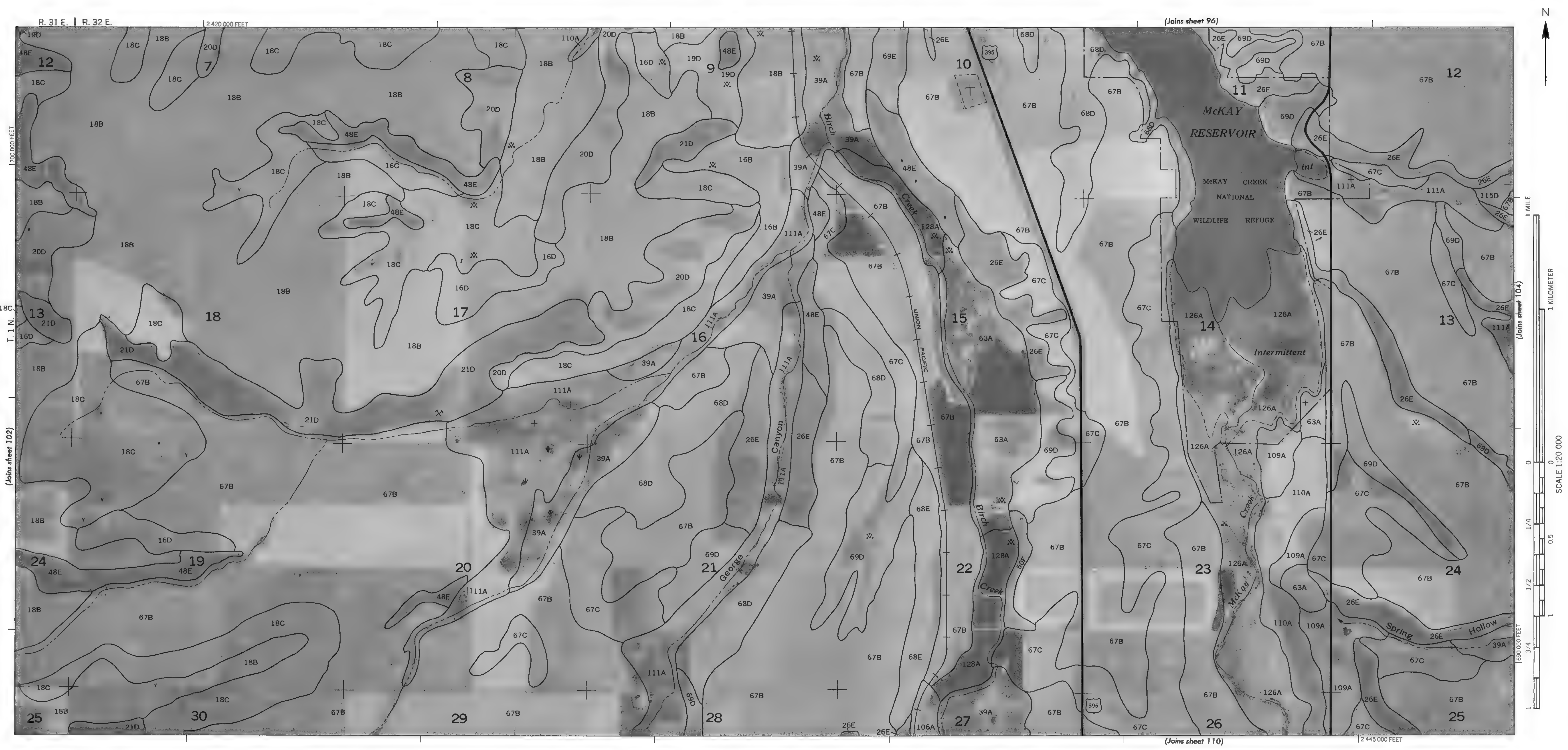



99
N
R. 34 E. | R. 35 E.
2 515 000 FEET
720 000 FEET
(Joins sheet 91)
(Joins inset B, sheet 83)
(Joins sheet 98)
(Joins sheet 106)
2 540 000 FEET
710 000 FEET
T. 2 N. | T. 1 N.
UMATILLA
INDIAN
RESERVATION
UMATILLA NATIONAL FOREST
Telephone Ridge
Little Squaw Creek
Squaw Creek
Bachelor Canyon
Gibbon Ridge
Buckaroo Creek
Wright Ridge
84
30
1 MILE
1 KILOMETER
SCALE 1:20 000

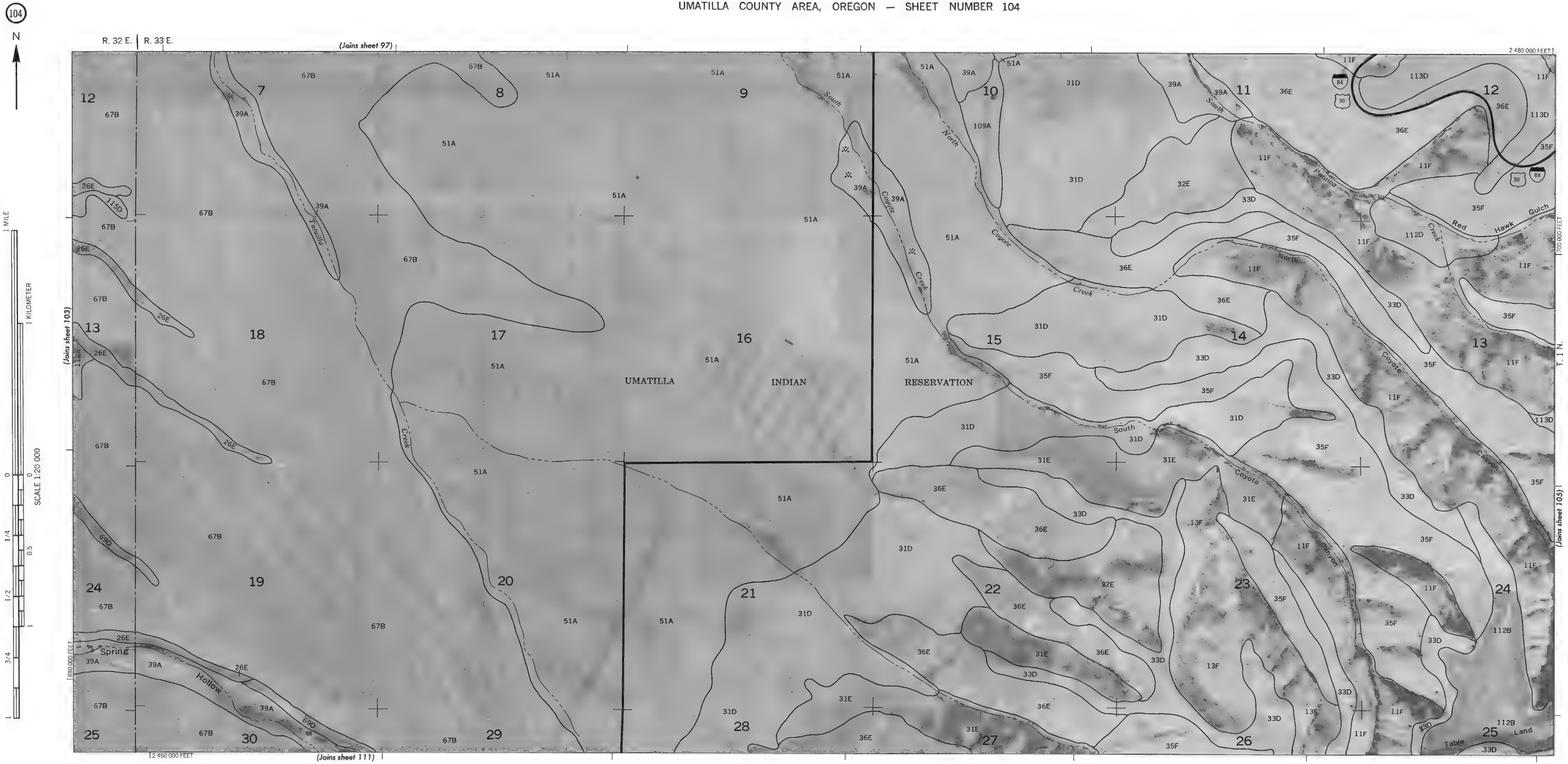

N
(Joins sheet 93)
R. 29 E.
2 350 000 FEET
700 000 FEET
T. 1 N.
(Joins sheet 101)
(Joins sheet 107)
2 325 000 FEET
690 000 FEET
MORROW COUNTY
Spikes Gulch
Spikes Gulch
Slusher Canyon
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
18B
18C
19D
20D
21D
43A
48E
50F
53D
56B
56C
57D
59D
60F
125F
16D
16E

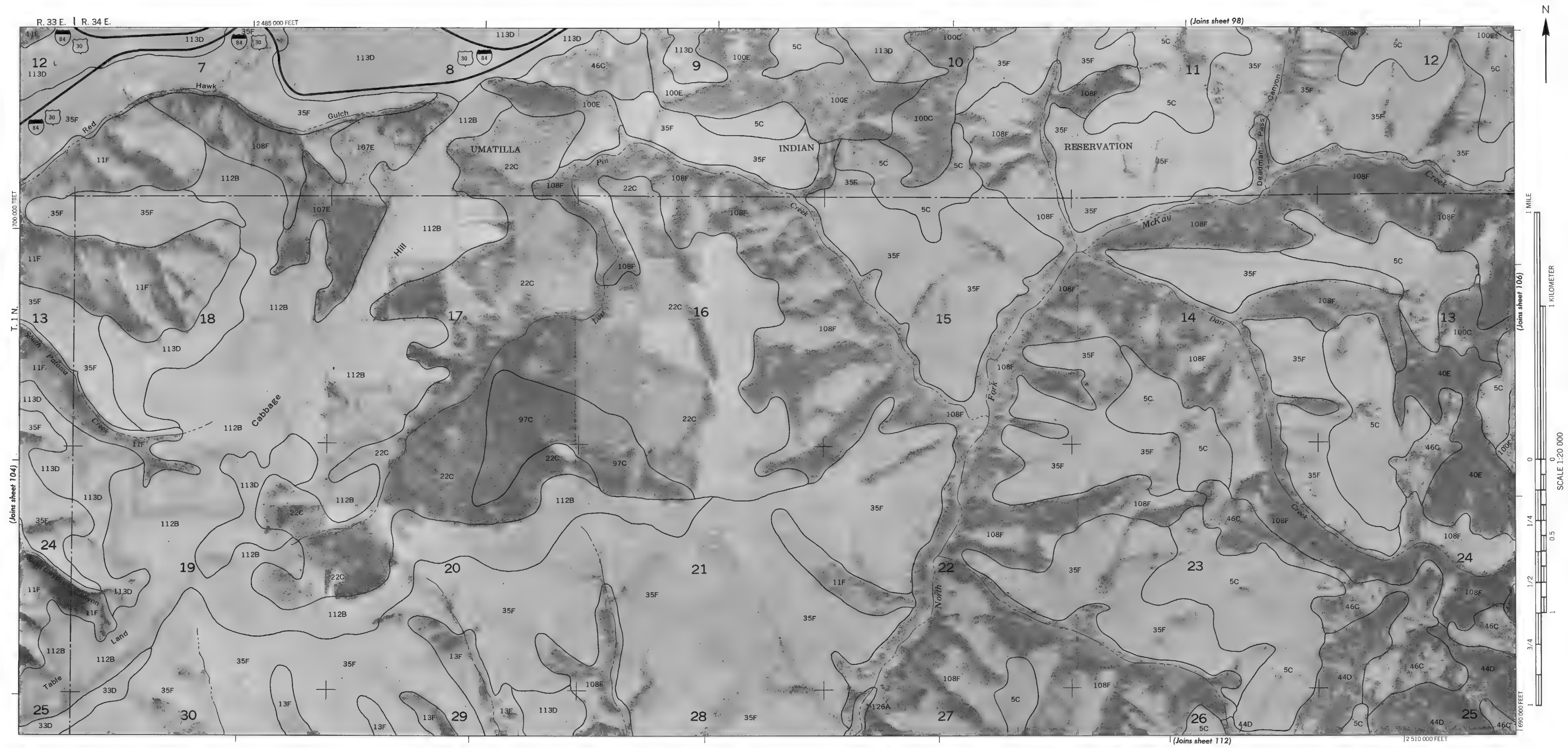

101
N
R. 29 E.
R. 30 E.
T. 1 N.
2 355 000 FEET
2 380 000 FEET
700 000 FEET
690 000 FEET
(Joins sheet 94)
(Joins sheet 100)
(Joins sheet 102)
(Joins sheet 108)
Alkali
Canyon
Spikes
Gulch
1 MILE
1 KILOMETER
SCALE 1:20 000


102
N
R. 30 E.
R. 31 E.
(Joins sheet 95)
2 415 000 FEET
700 000 FEET
(Joins sheet 101)
(Joins sheet 103)
T. 1 N.
690 000 FEET
2 385 000 FEET
(Joins sheet 109)
Coombs
Canyon
Coombs
Canyon
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1

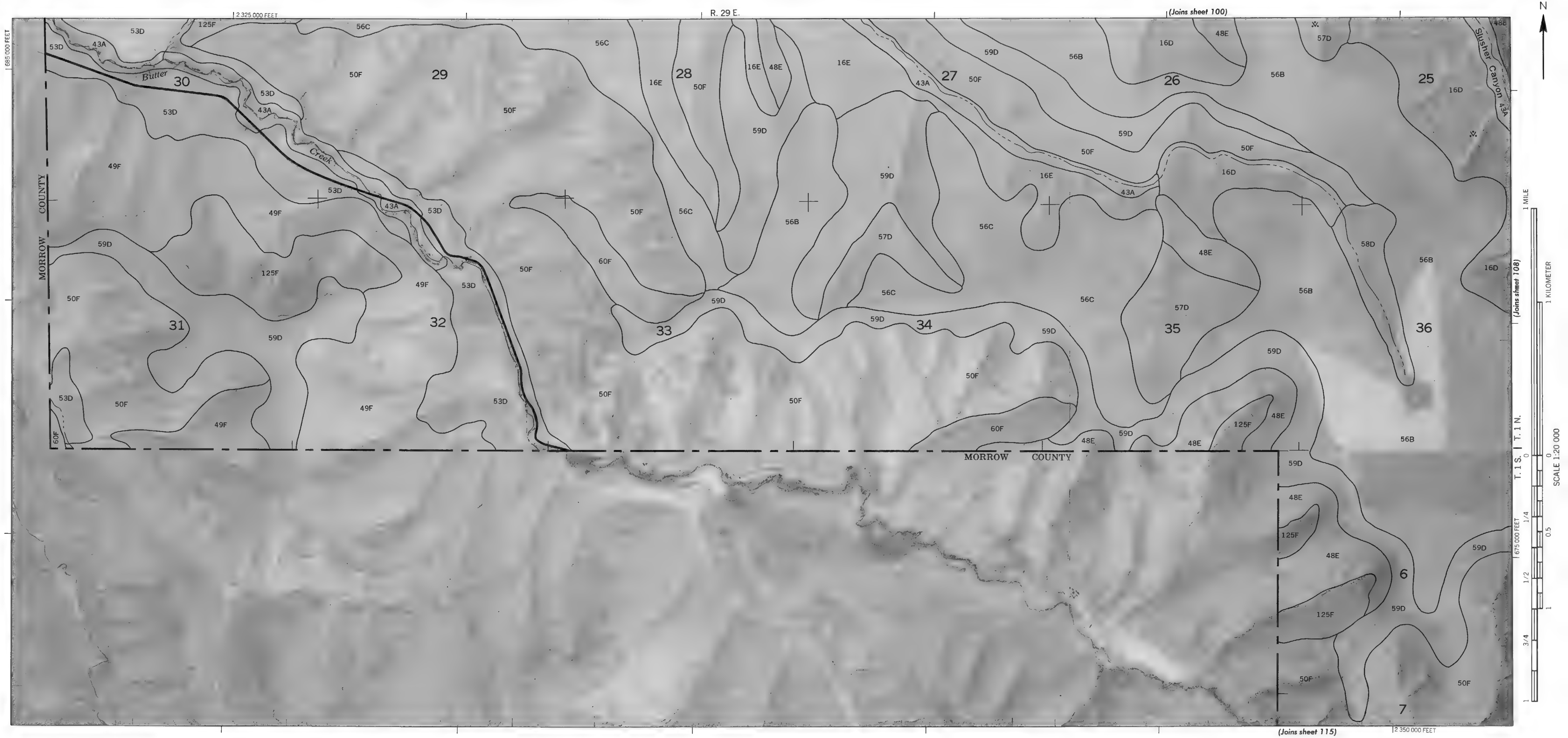


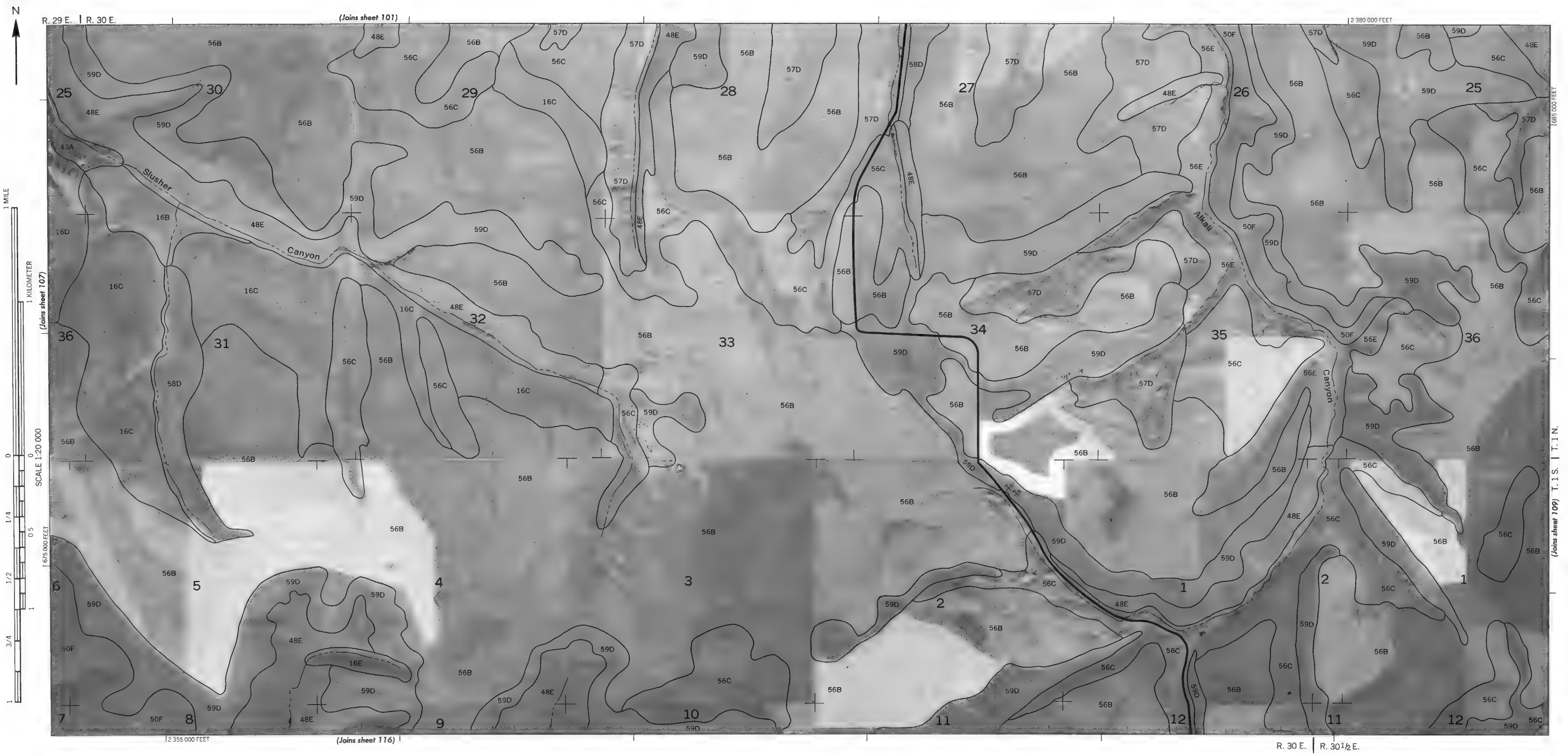
103
N
R. 31 E. | R. 32 E.
2 420 000 FEET
(Joins sheet 96)
(Joins sheet 102)
(Joins sheet 104)
(Joins sheet 110)
T. 1 N.
700 000 FEET
690 000 FEET
2 445 000 FEET
McKAY RESERVOIR
McKAY CREEK NATIONAL WILDLIFE REFUGE
intermittent
Birch Creek
McKay Creek
George Canyon
UNION PACIFIC
Spring Hollow
395
SCALE 1:20 000
1 MILE
1 KILOMETER

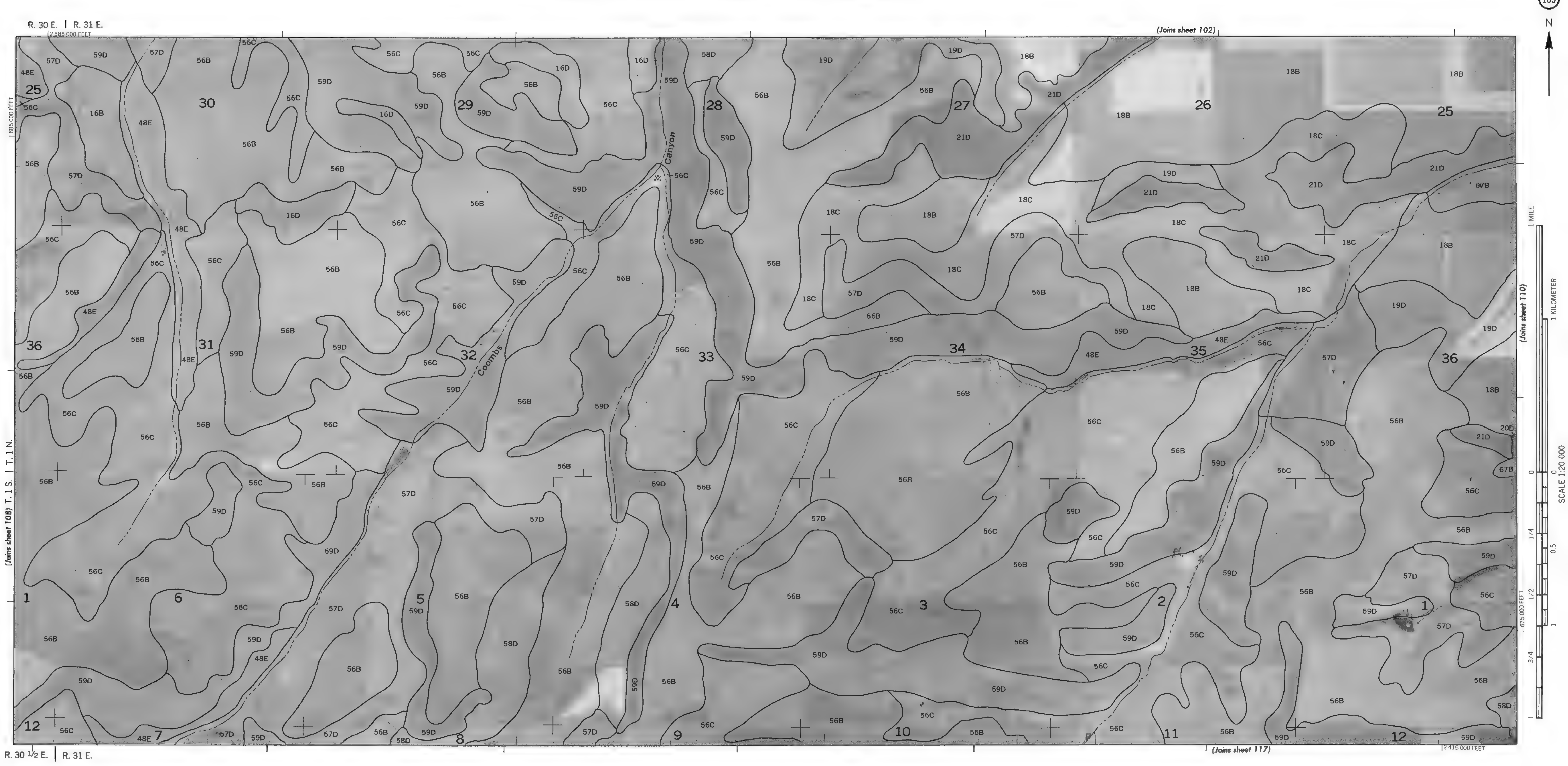

104
N
R. 32 E.
R. 33 E.
(Joins sheet 97)
(Joins sheet 103)
(Joins sheet 105)
(Joins sheet 111)
2 480 000 FEET
2 450 000 FEET
700 000 FEET
690 000 FEET
T. 1 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
UMATILLA
INDIAN
RESERVATION
South
North
Coyote
Creek
Tutuilla
Patawa
Red
Hawk
Gulch
Canyon
Spring
Hollow
Table
Land
84
30
12
7
8
9
10
11
12
13
18
17
16
15
14
13
24
19
20
21
22
23
24
25
30
29
28
27
26
25
67B
51A
39A
26E
115D
69D
109A
31D
31E
32E
33D
35F
36E
11F
13F
32E
112B
112D
113D

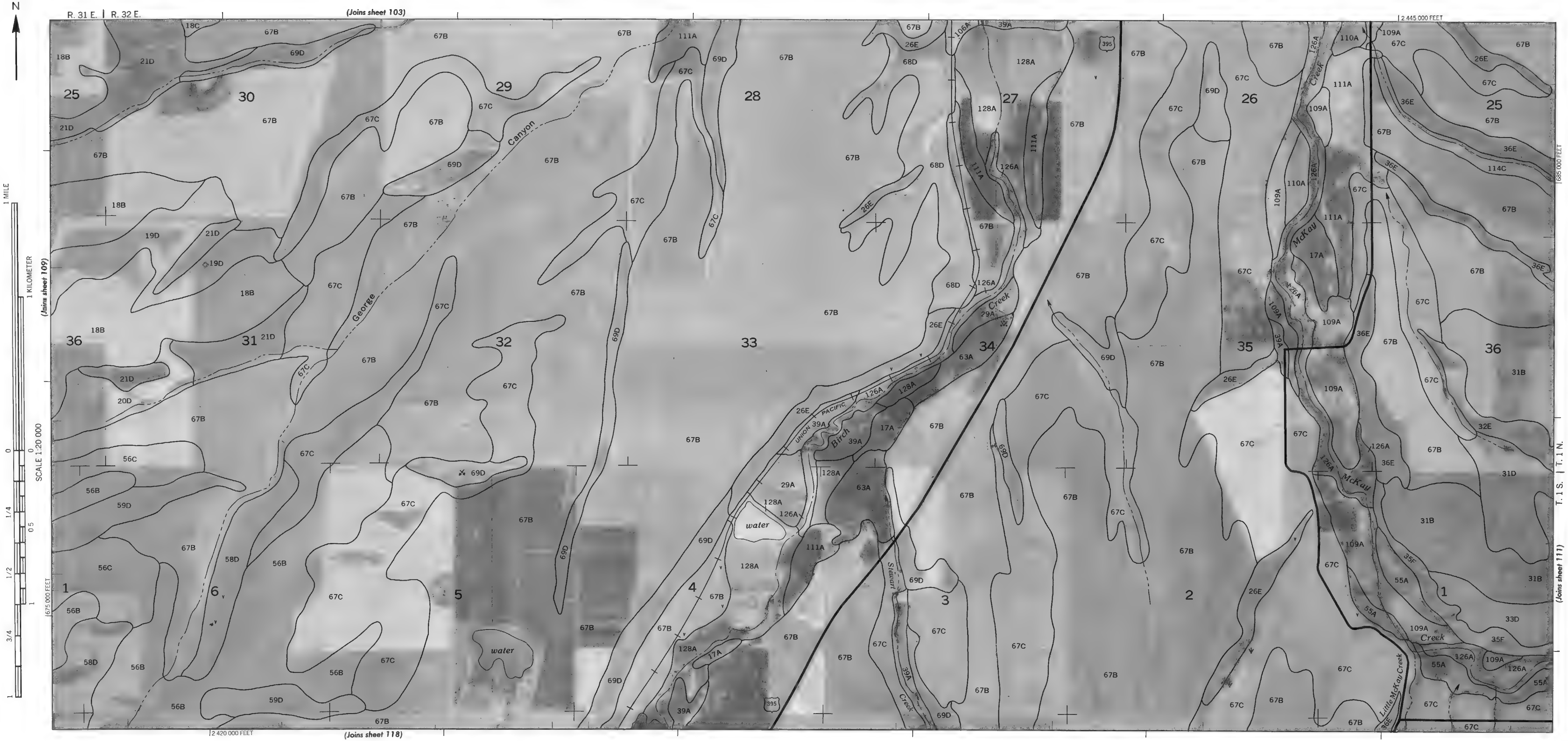

N
R. 33 E.
R. 34 E.
2 485 000 FEET
(Joins sheet 98)
(Joins sheet 106)
(Joins sheet 104)
(Joins sheet 112)
2 510 000 FEET
700 000 FEET
690 000 FEET
T. 1 N.
UMATILLA
INDIAN
RESERVATION
Hawk
Gulch
Red
Hill
Pin
Creek
Lost
Cabbage
South
Patawa
Creek
Table
Land
Canyon
Deadman
Pass
Canyon
McKay
Creek
Darr
Creek
North
Fork
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5


106
N
R. 34 E.
R. 35 E.
(Joins sheet 99)
(Joins sheet 113)
(Joins sheet 105)
(Joins inset, sheet 114)
T. 1 N.
2 540 000 FEET
2 515 000 FEET
705 000 FEET
690 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
UMATILLA INDIAN RESERVATION
UMATILLA NATIONAL FOREST
North Fork McKay Creek
Squaw Creek
Light Ridge
Dry Creek
84
30
5C
35F
46C
97C
97E
100C
100E
108F
44D

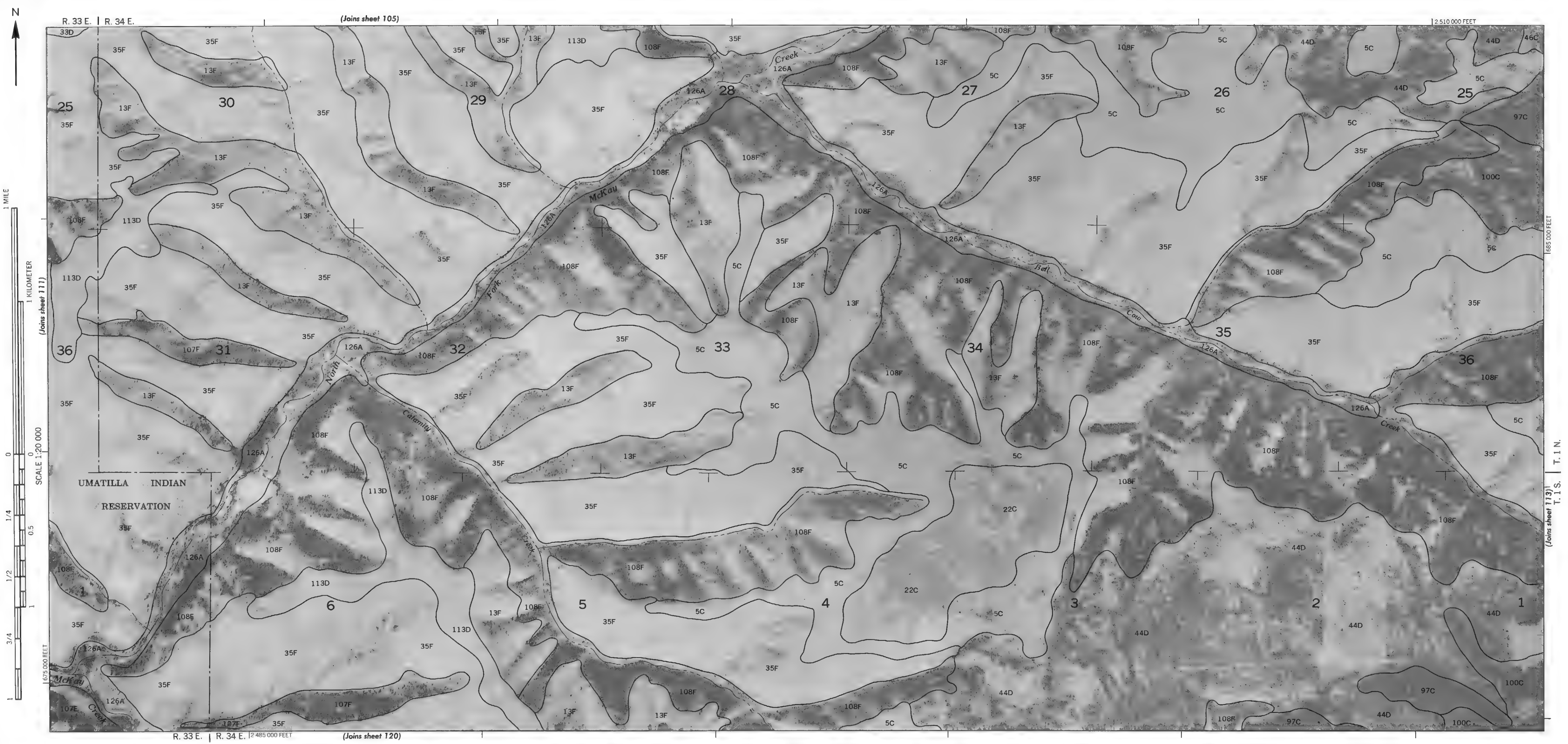

(Joins sheet 100)
(Joins sheet 108)
(Joins sheet 115)
R. 29 E.
T. 1 N.
T. 1 S.
2 325 000 FEET
2 350 000 FEET
685 000 FEET
675 000 FEET
N
MORROW COUNTY
MORROW COUNTY
Butter Creek
Slusher Canyon
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
25
26
27
28
29
30
31
32
33
34
35
36
6
7
53D
43A
125F
56C
50F
49F
59D
16E
48E
16D
56B
57D
58D
60F
57D


N
R. 29 E. | R. 30 E.
(Joins sheet 101)
2 380 000 FEET
685 000 FEET
(Joins sheet 107)
(Joins sheet 109)
T. 1 N. | T. 1 S.
(Joins sheet 116)
2 355 000 FEET
675 000 FEET
R. 30 E. | R. 30 1/2 E.
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
Slusher
Canyon
Alkali
Canyon
25
30
29
28
27
26
25
36
31
32
33
34
35
36
6
5
4
3
2
1
2
1
7
8
9
10
11
12
11
12
56B
56C
59D
48E
16B
16C
16D
16E
43A
57D
58D
50F
56E

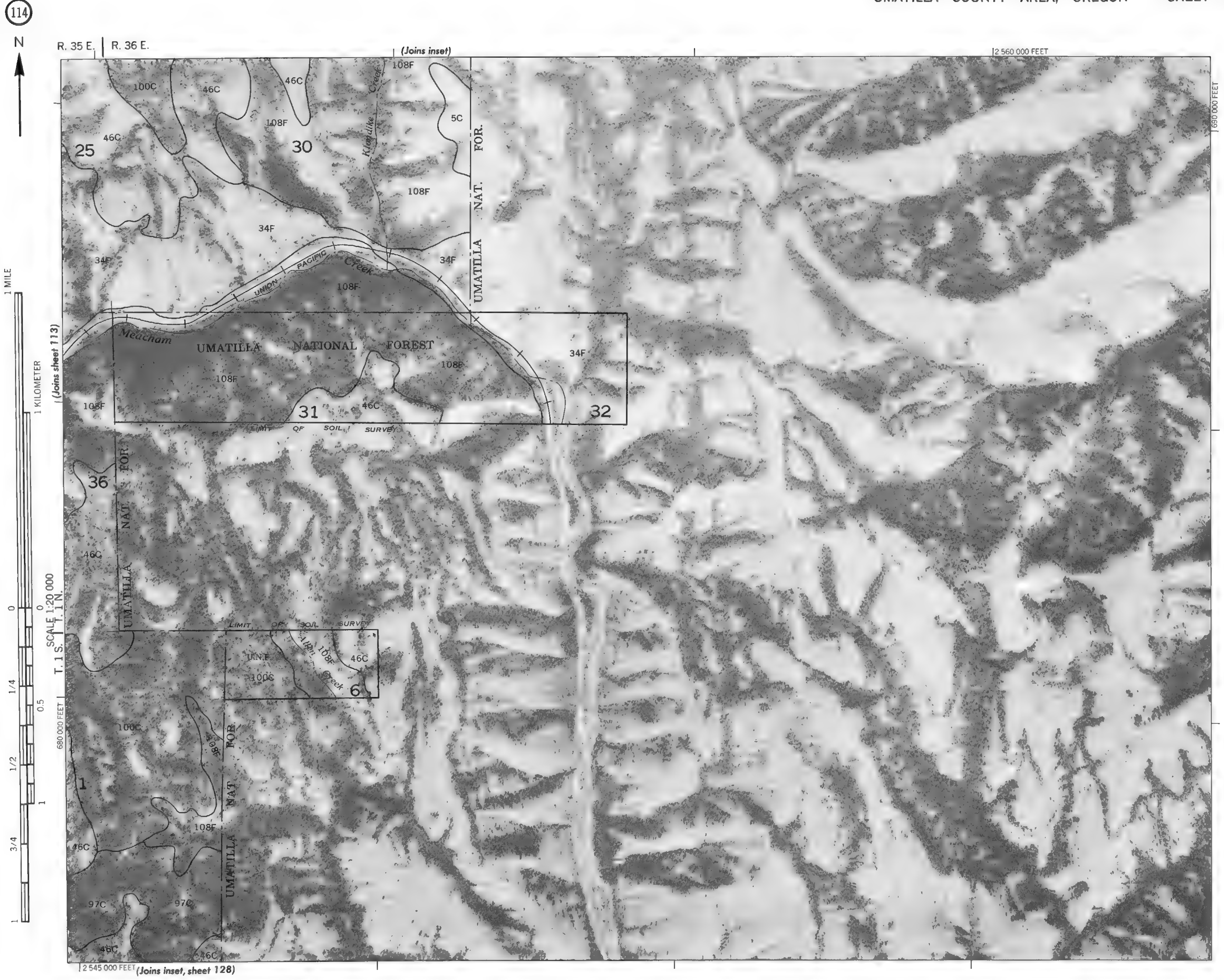

109
N
R. 30 E. | R. 31 E.
2 385 000 FEET
(Joins sheet 102)
685 000 FEET
(Joins sheet 108)
T. 1 N. | T. 1 S.
(Joins sheet 110)
675 000 FEET
R. 30 1/2 E. | R. 31 E.
(Joins sheet 117)
2 415 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
Coombs
Canyon
25
30
29
28
27
26
25
36
31
32
33
34
35
36
1
6
5
4
3
2
1
12
7
8
9
10
11
12

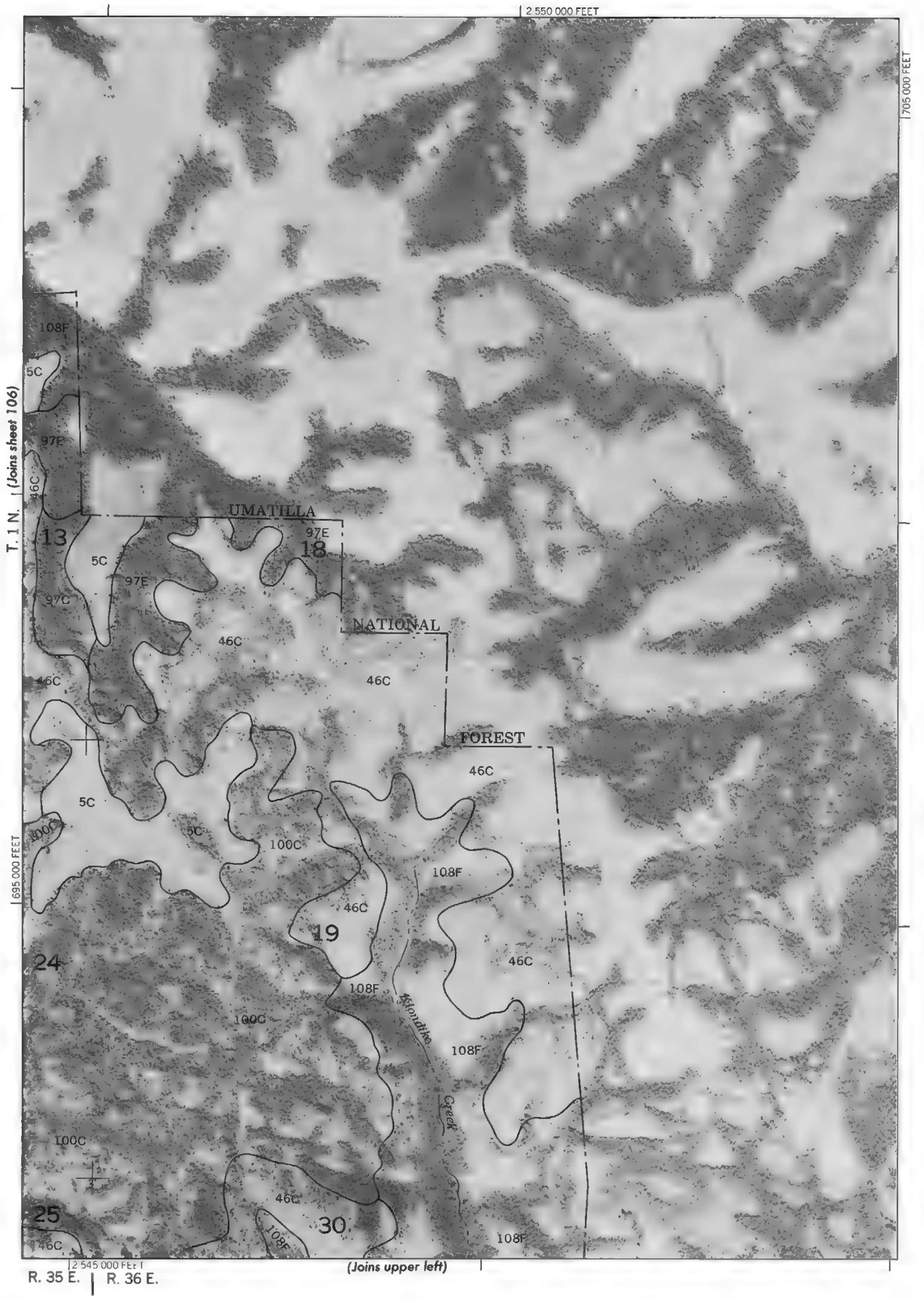

N
R. 31 E. | R. 32 E.
(Joins sheet 103)
(Joins sheet 109)
(Joins sheet 111)
(Joins sheet 118)
2 445 000 FEET
685 000 FEET
675 000 FEET
2 420 000 FEET
T. 1 S. | T. 1 N.
1 MILE
1 KILOMETER
SCALE 1:20 000
George Canyon
Birch Creek
UNION PACIFIC
Stewart Creek
McKay Creek
Little McKay Creek
water
395
25
30
29
28
27
26
36
31
32
33
34
35
1
6
5
4
3
2


111
N
R. 32 E.
R. 33 E.
2 450 000 FEET
(Joins sheet 104)
(Joins sheet 119)
(Joins sheet 110)
(Joins sheet 112)
685 000 FEET
675 000 FEET
2 480 000 FEET
T. 1 N.
T. 1 S.
UMATILLA
INDIAN
RESERVATION
Spring
Hollow
Table Rock
Table Land
McKay Creek
1 MILE
1 KILOMETER
SCALE 1:20 000

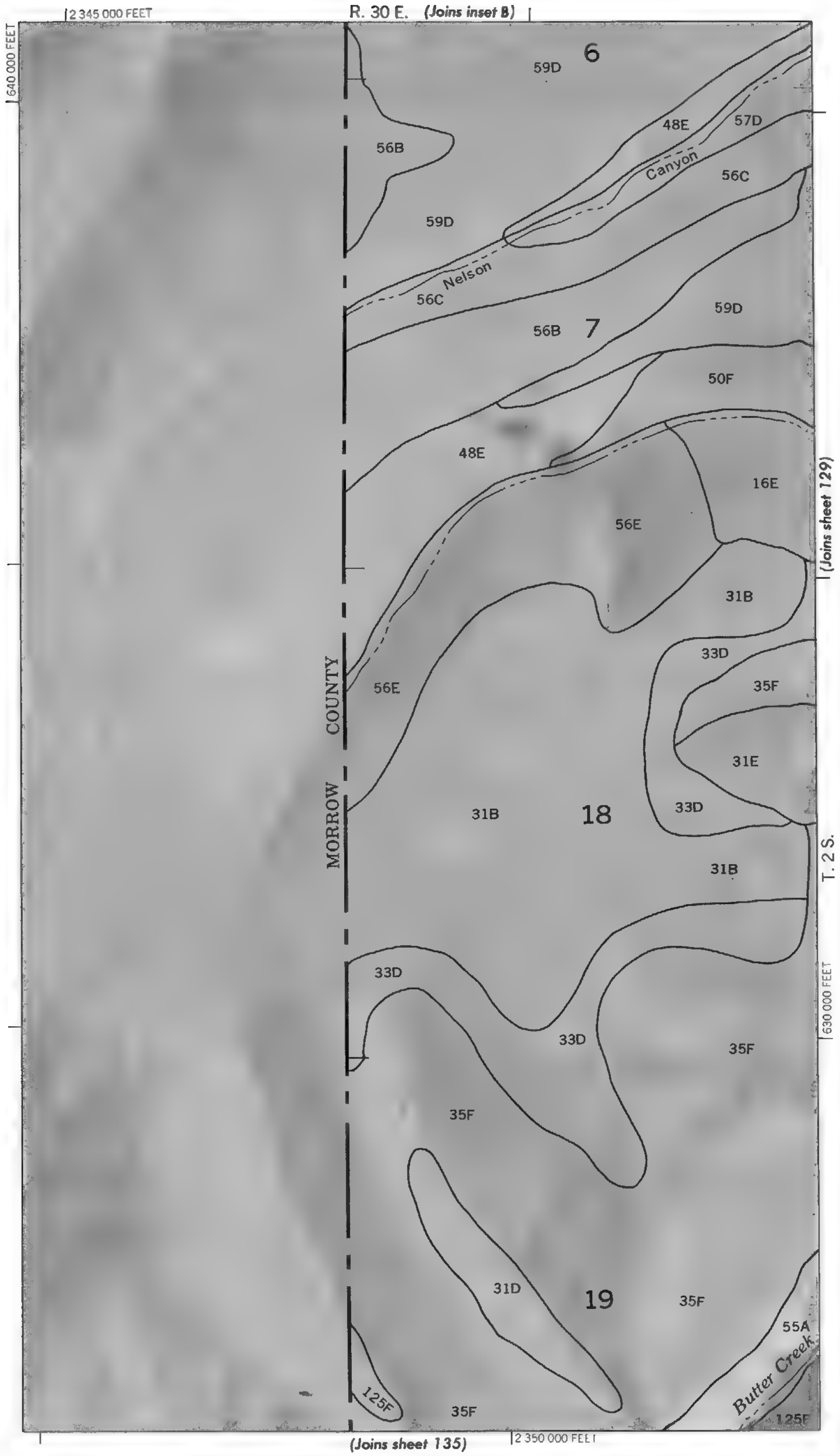

112
N
R. 33 E. | R. 34 E.
(Joins sheet 105)
2 510 000 FEET
(Joins sheet 111)
(Joins sheet 113)
685 000 FEET
T. 1 N.
T. 1 S.
R. 33 E. | R. 34 E.
2 485 000 FEET
(Joins sheet 120)
675 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
UMATILLA INDIAN
RESERVATION
McKay Creek
North Fork McKay Creek
Calamity Creek
Bell Cow Creek
25
30
29
28
27
26
36
31
32
33
34
35
6
5
4
3
2
1
33D
35F
13F
113D
108F
126A
5C
44D
46C
97C
100C
107F
22C


N
(Joins sheet 106)
(Joins sheet 121)
(Joins sheet 112)
(Joins sheet 114)
R. 34 E. | R. 35 E.
T. 1 S. | T. 1 N.
2 515 000 FEET
2 540 000 FEET
685 000 FEET
680 000 FEET
Meacham
Meacham Creek
Twomile Creek
Mill Creek
Sheep Creek
Bell
Cow Creek
Beaver Creek
UNION PACIFIC
84
30
25
26
27
28
29
30
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
1 MILE
1 KILOMETER
SCALE 1:20 000

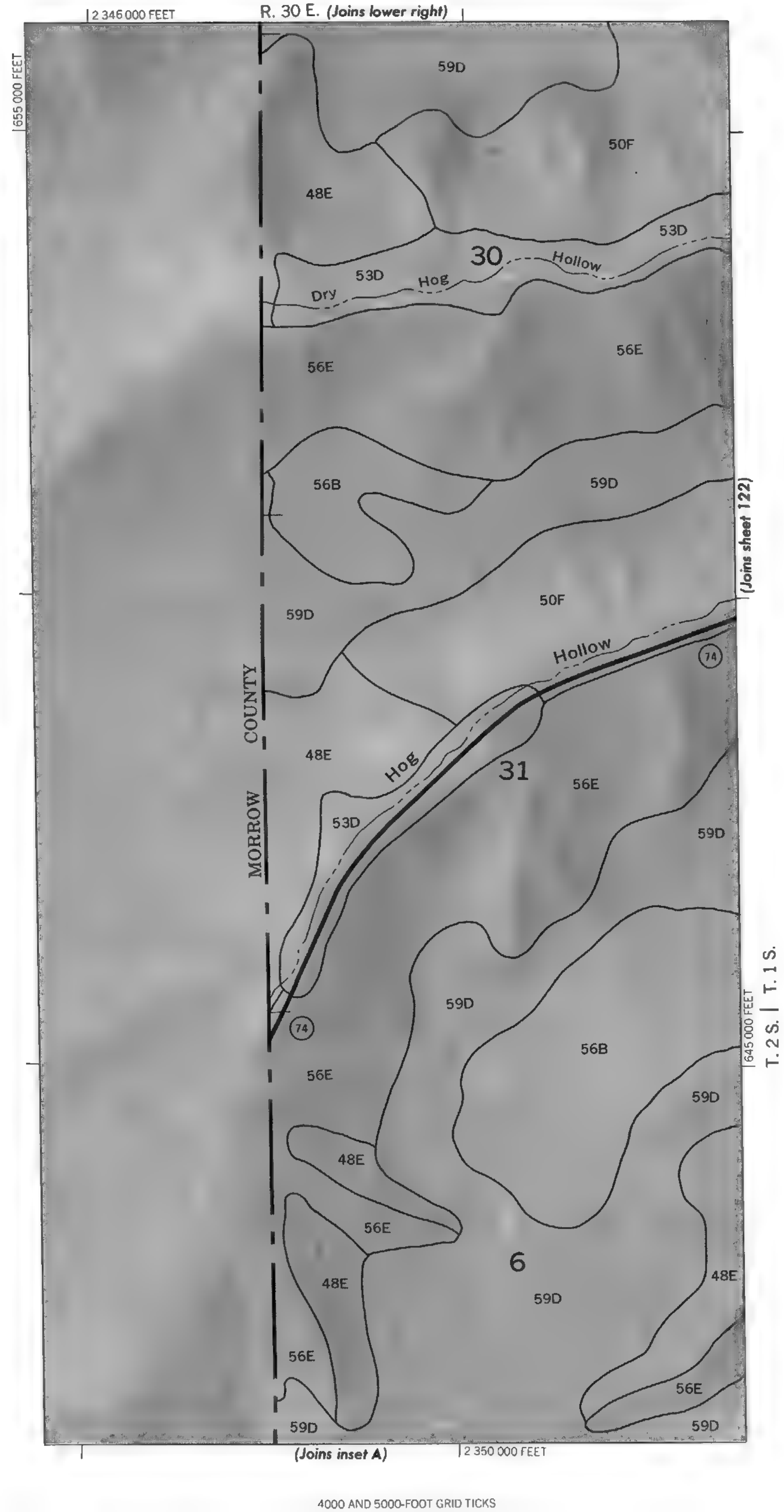

114
N
R. 35 E.
R. 36 E.
(Joins inset)
2 560 000 FEET
690 000 FEET
(Joins sheet 113)
680 000 FEET
2 545 000 FEET
(Joins inset, sheet 128)
1 MILE
1 KILOMETER
SCALE 1:20 000
T. 1 N.
T. 1 S.
UMATILLA NATIONAL FOREST
UMATILLA NAT. FOR.
LIMIT OF SOIL SURVEY
Meacham Creek
UNION PACIFIC
Klondike Creek
25
30
31
32
36
6
1
100C
46C
108F
5C
34F
97C
U.N.F.

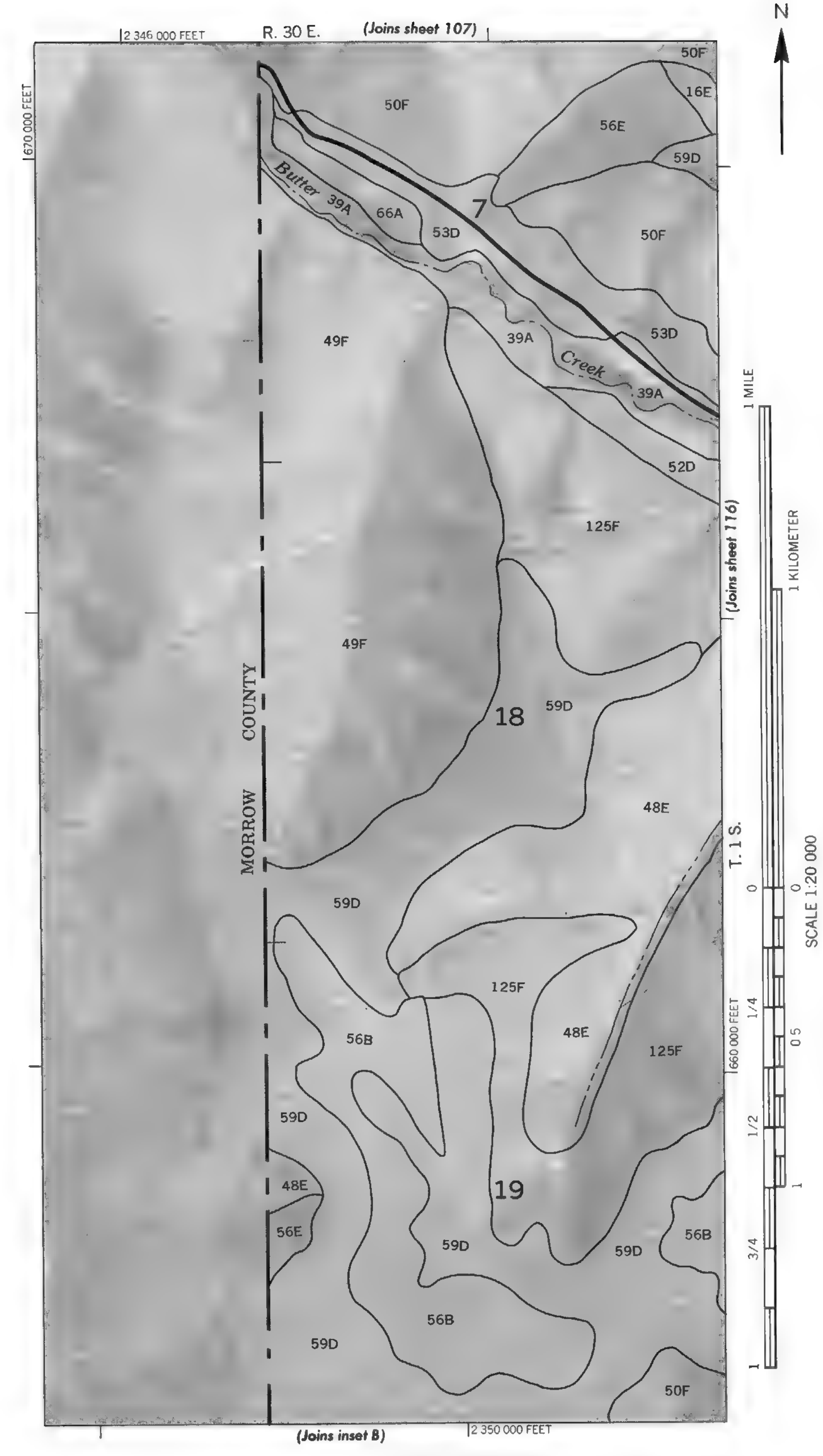

2 550 000 FEET
705 000 FEET
695 000 FEET
(Joins sheet 106)
T. 1 N.
UMATILLA
NATIONAL
FOREST
Klondike Creek
13
18
19
24
25
30
5C
97E
97C
46C
100C
108F
2 545 000 FEET
(Joins upper left)
R. 35 E.
R. 36 E.

INSET A

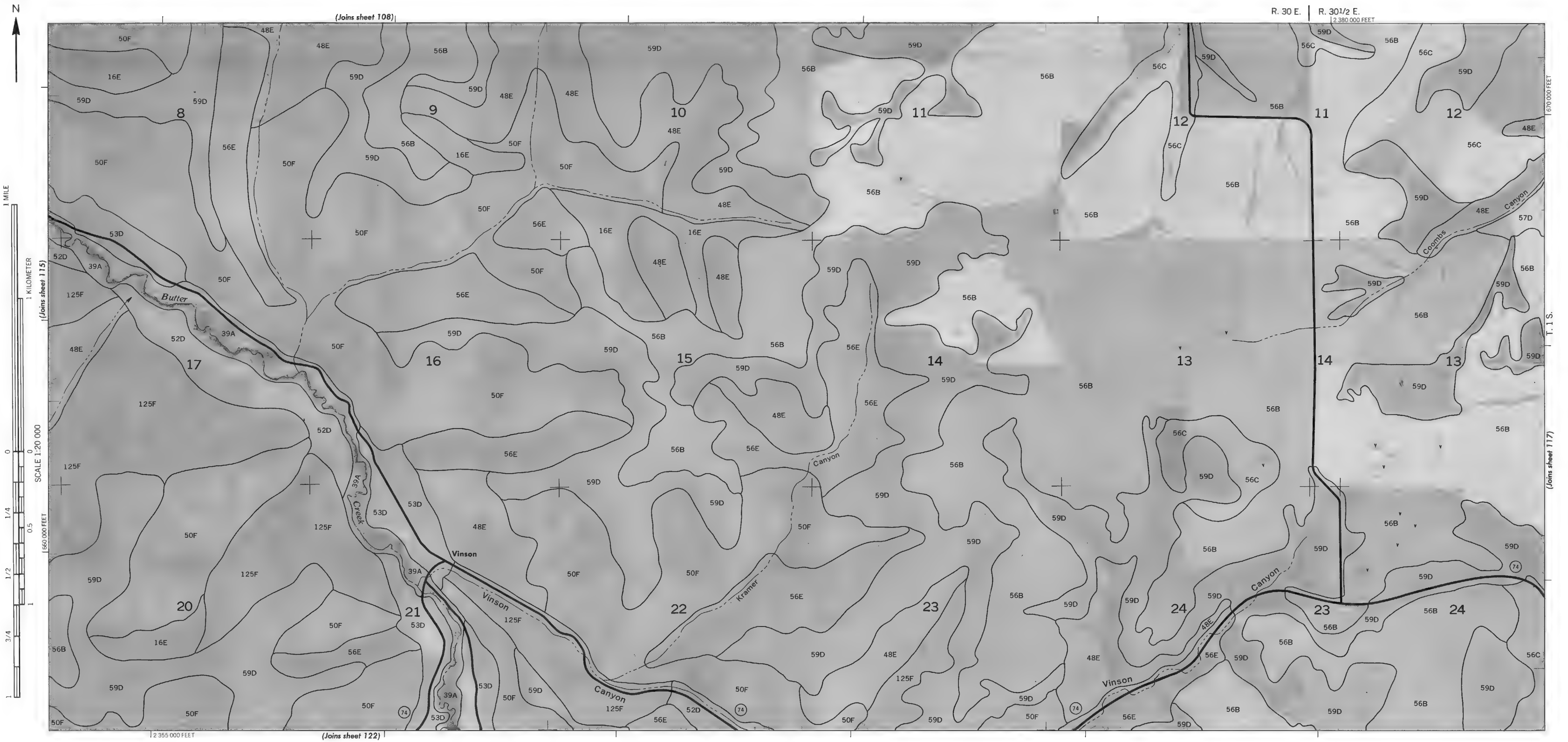


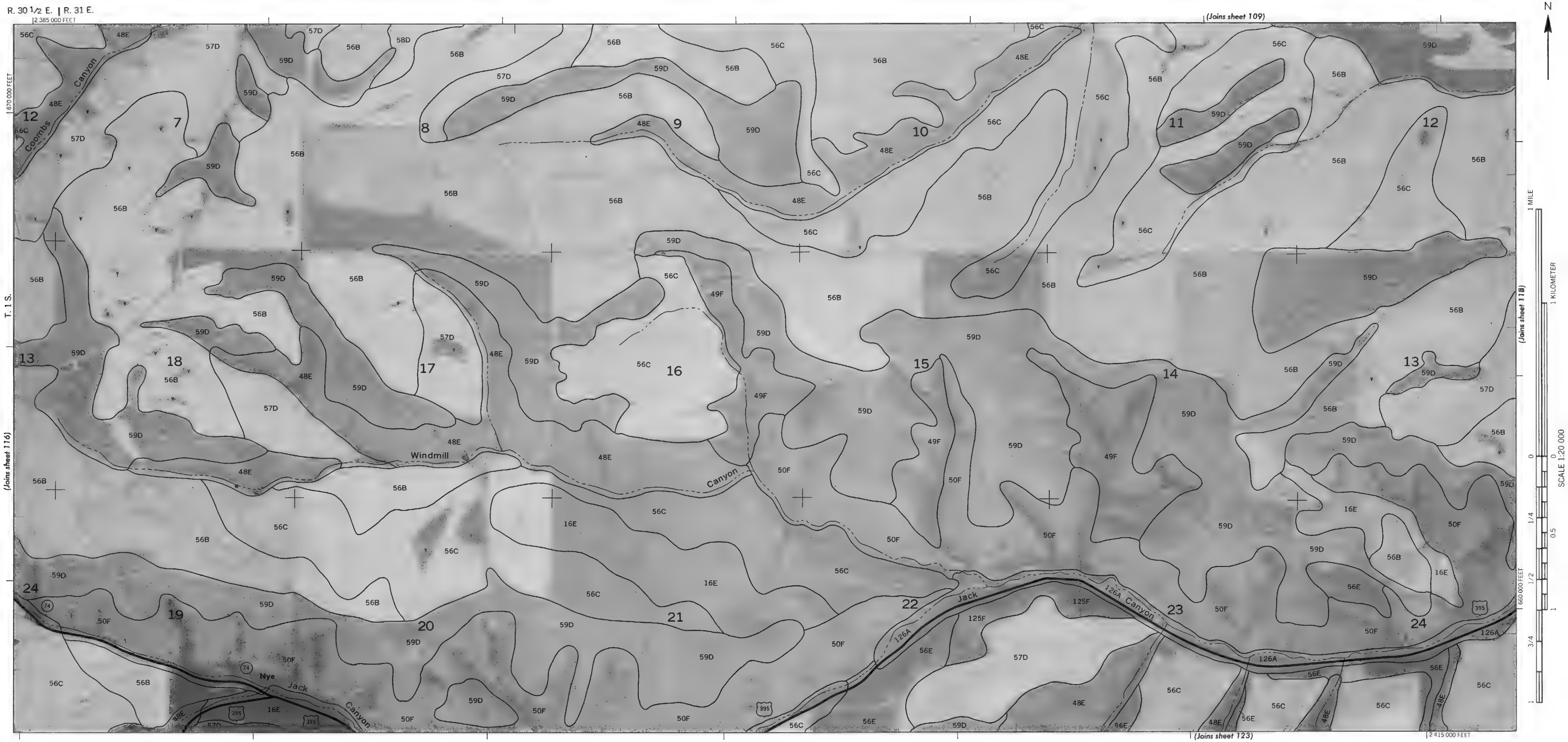
INSET B

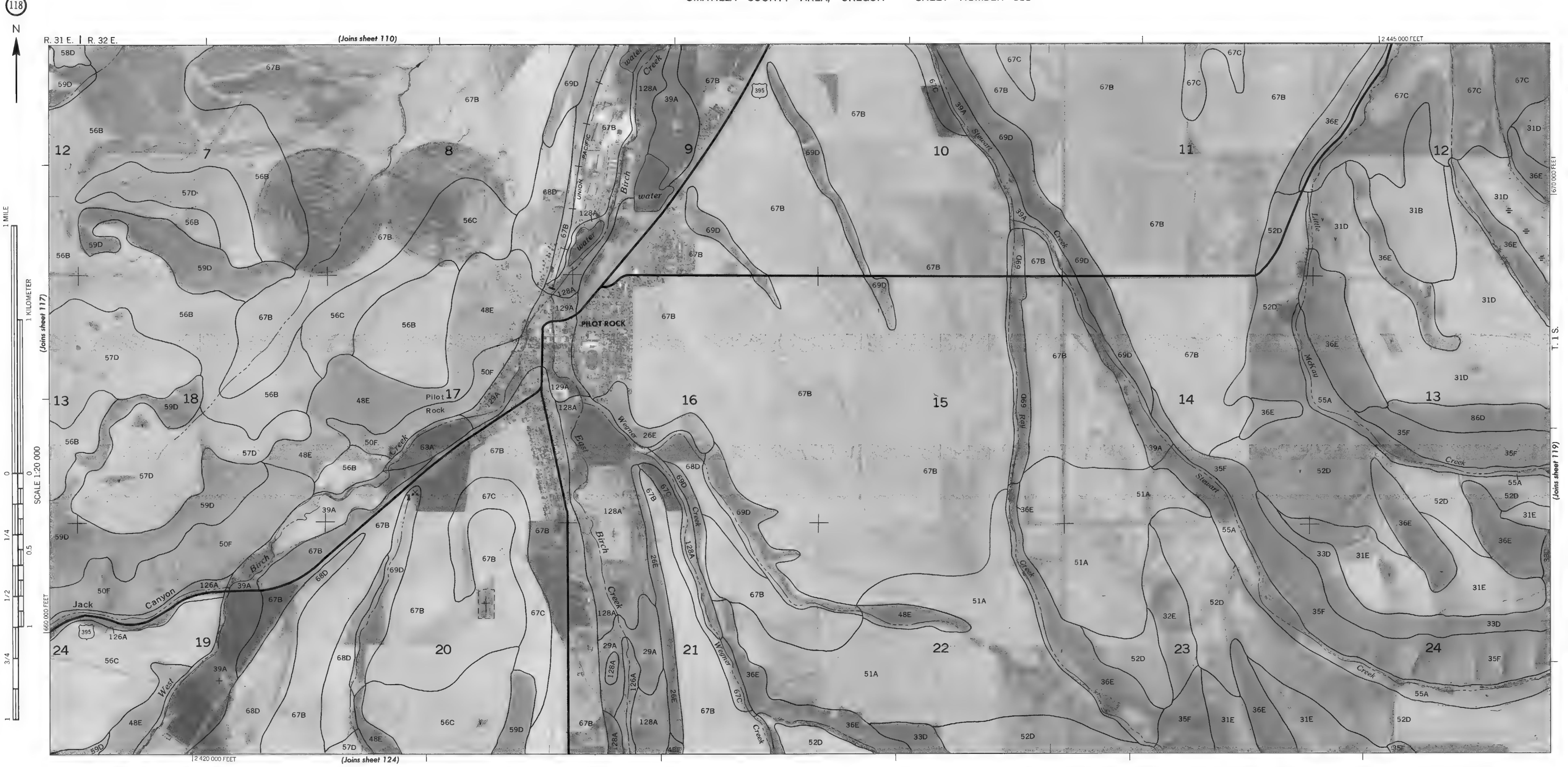


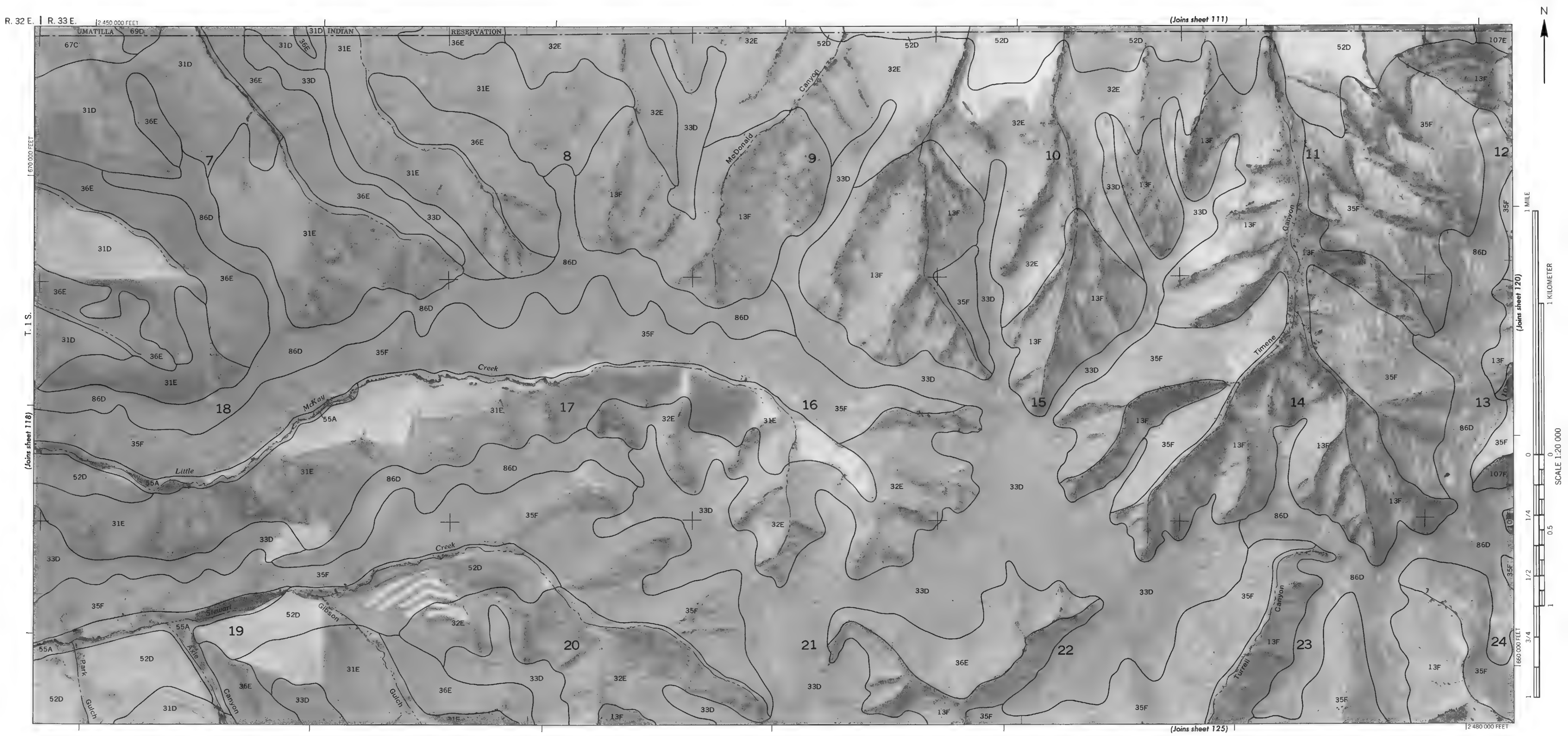


UMATILLA COUNTY AREA, OREGON — SHEET NUMBER 116

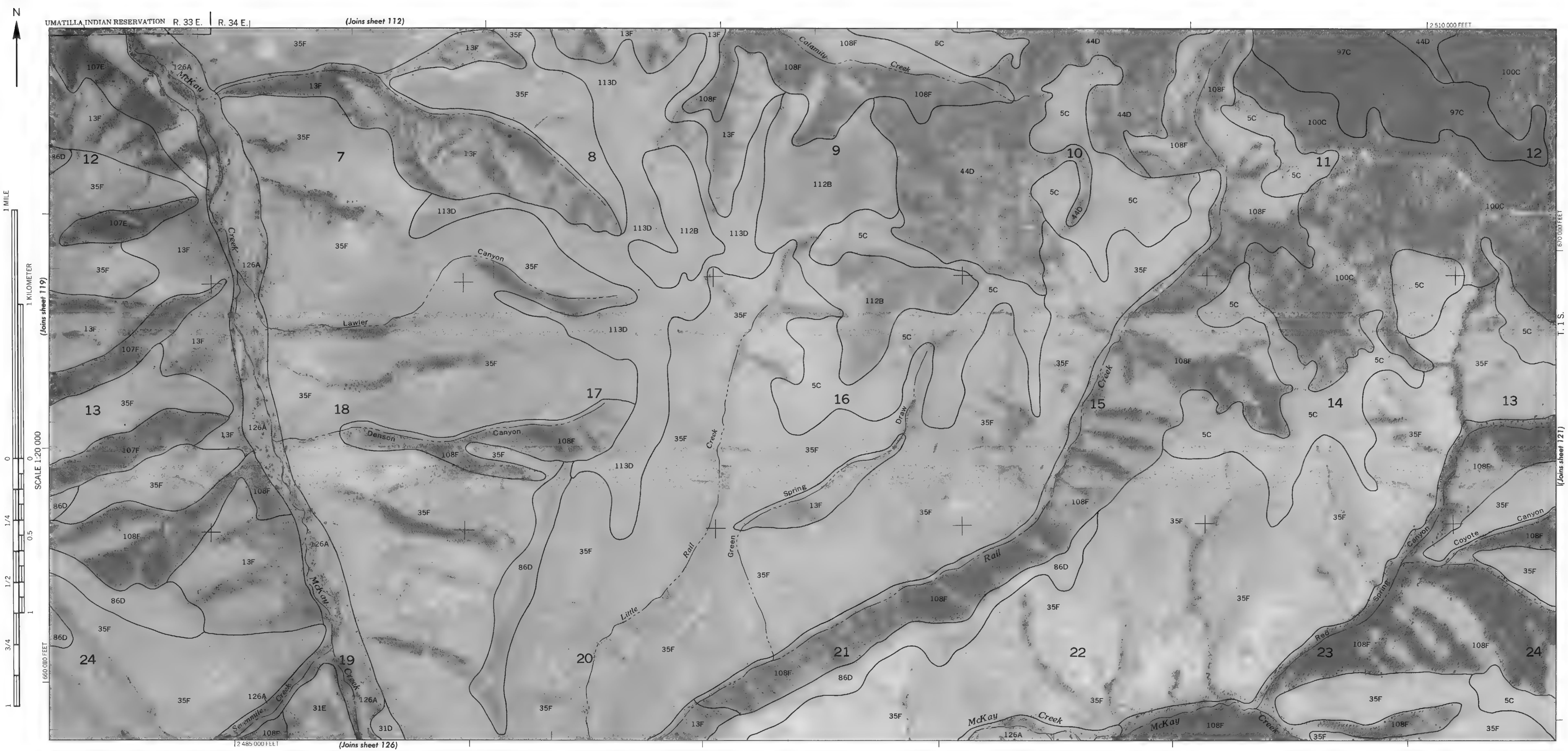


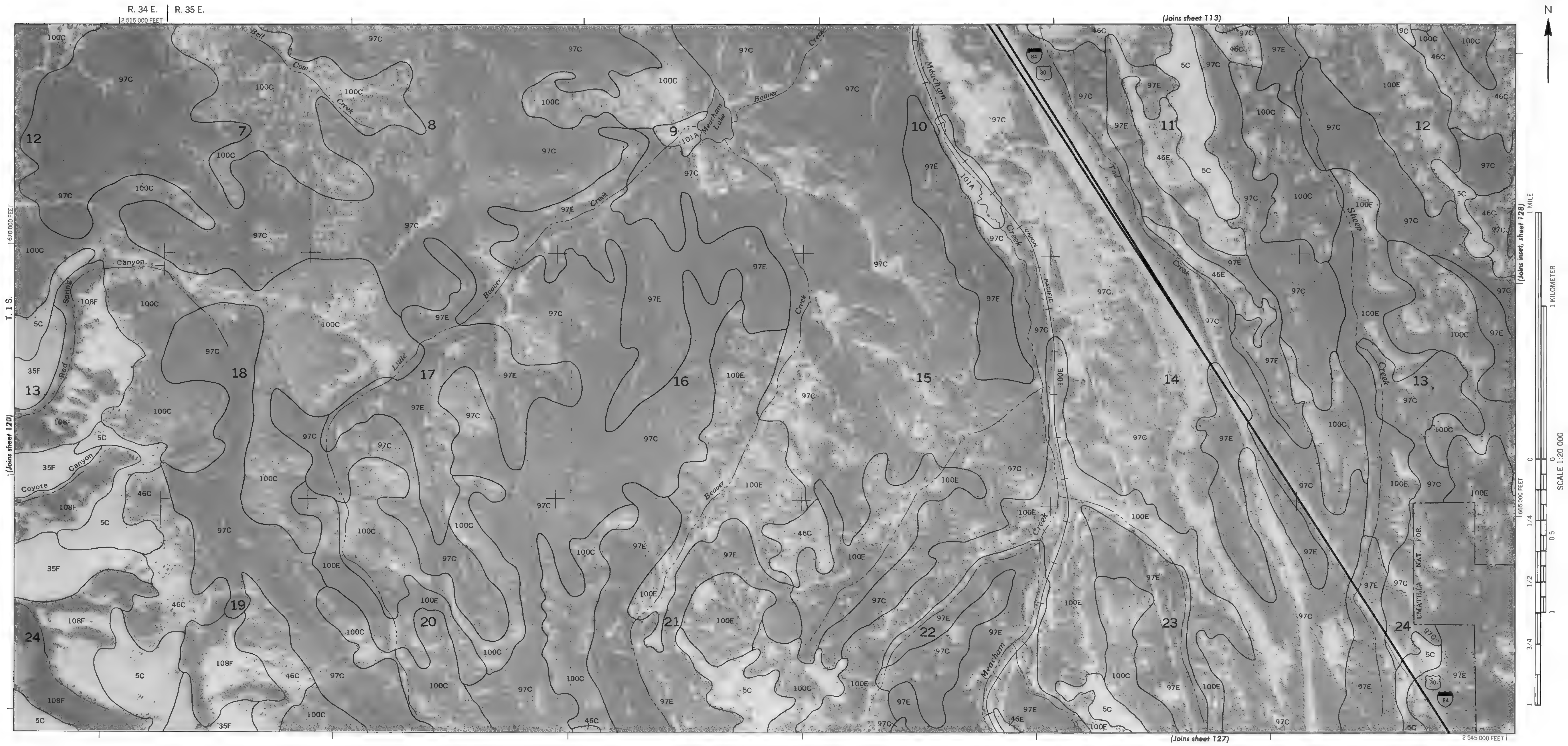

R. 30 1/2 E. | R. 31 E.
2 385 000 FEET
(Joins sheet 109)
670 000 FEET
T. 1 S.
(Joins sheet 116)
(Joins sheet 118)
(Joins sheet 123)
660 000 FEET
2 415 000 FEET
N
Coombs Canyon
Windmill Canyon
Jack Canyon
Nye
74
395
1 MILE
1 KILOMETER
SCALE 1:20 000
56C
48E
57D
59D
56B
58D
56B
57D
59D
56B
56C
56B
59D
56B
48E
56C
59D
12
48E
66C
57D
7
59D
8
59D
56B
48E
9
59D
10
48E
56C
11
59D
59D
12
56B
56C
56B
56C
56B
56B
56C
48E
56C
56B
56C
56B
56C
56B
59D
59D
56B
56C
49F
59D
56B
56C
56B
59D
57D
59D
59D
13
59D
18
56B
48E
57D
17
48E
59D
56C
16
59D
15
49F
14
56B
59D
13
59D
57D
56B
56B
59D
57D
59D
48E
48E
Windmill
48E
59D
59D
49F
50F
59D
49F
59D
56B
56B
56B
56B
50F
56C
56C
16E
56C
50F
56C
56B
56C
50F
59D
16E
50F
59D
59D
56B
16E
56E
50F
24
59D
59D
19
50F
20
56B
56C
16E
21
56C
22
125F
23
50F
24
50F
126A
125F
56E
57D
59D
59D
50F
50F
56C
56B
74
Nye
16E
48E
57D
59D
50F
50F
50F
56C
56E
59D
48E
56E
56C
48E
56E
56C
56E
56C
126A
56E
48E
56C

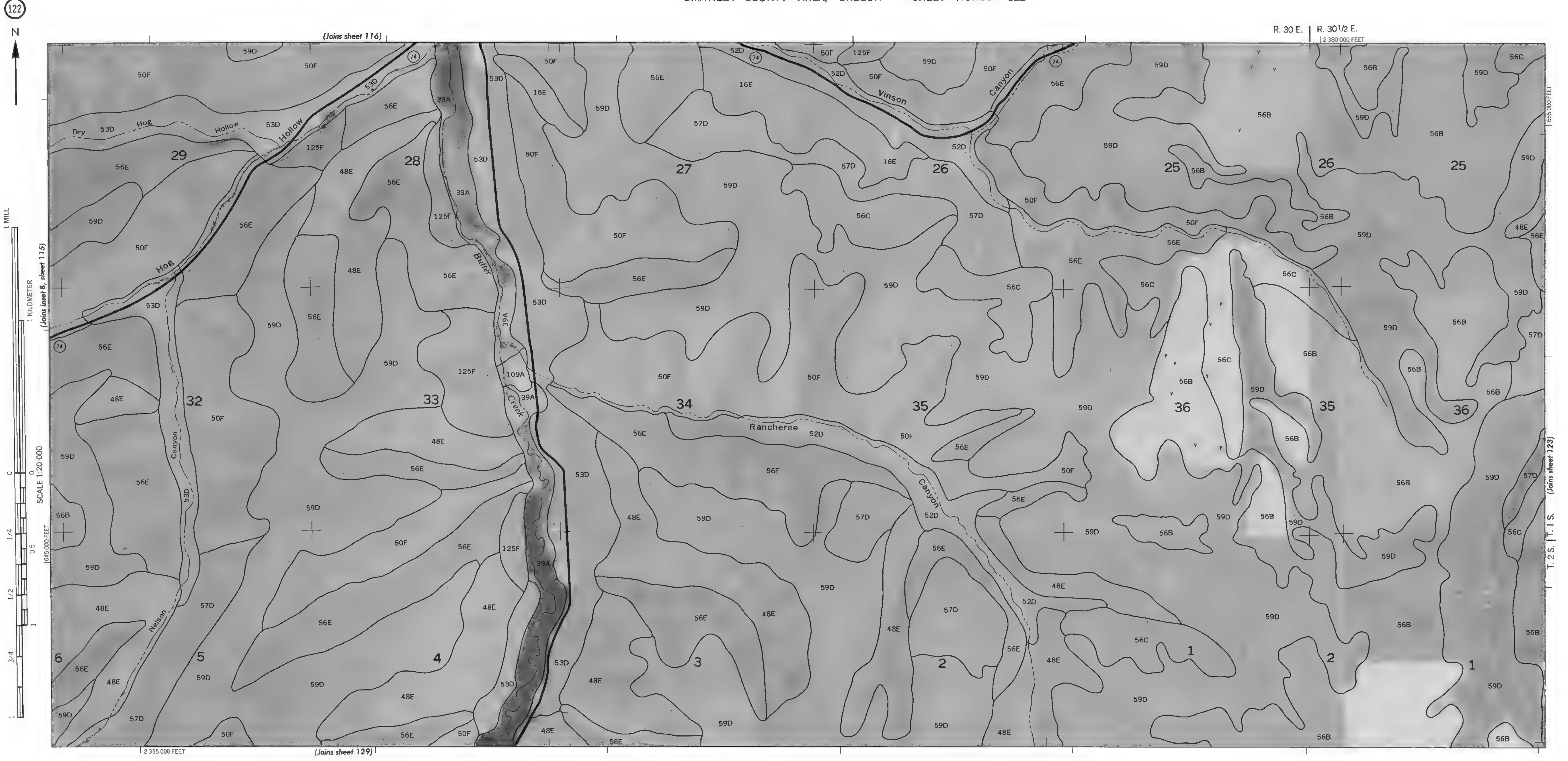

118
N
R. 31 E. R. 32 E.
(Joins sheet 110)
(Joins sheet 117)
(Joins sheet 119)
(Joins sheet 124)
2 445 000 FEET
2 420 000 FEET
660 000 FEET
670 000 FEET
T. 1 S.
PILOT ROCK
Pilot Rock Creek
Birch Creek
East Birch Creek
Wagner Creek
Stewart Creek
Little McKay Creek
Ray Creek
West Birch
Jack Canyon
UNION PACIFIC
395
1 MILE
1 KILOMETER
SCALE 1:20 000

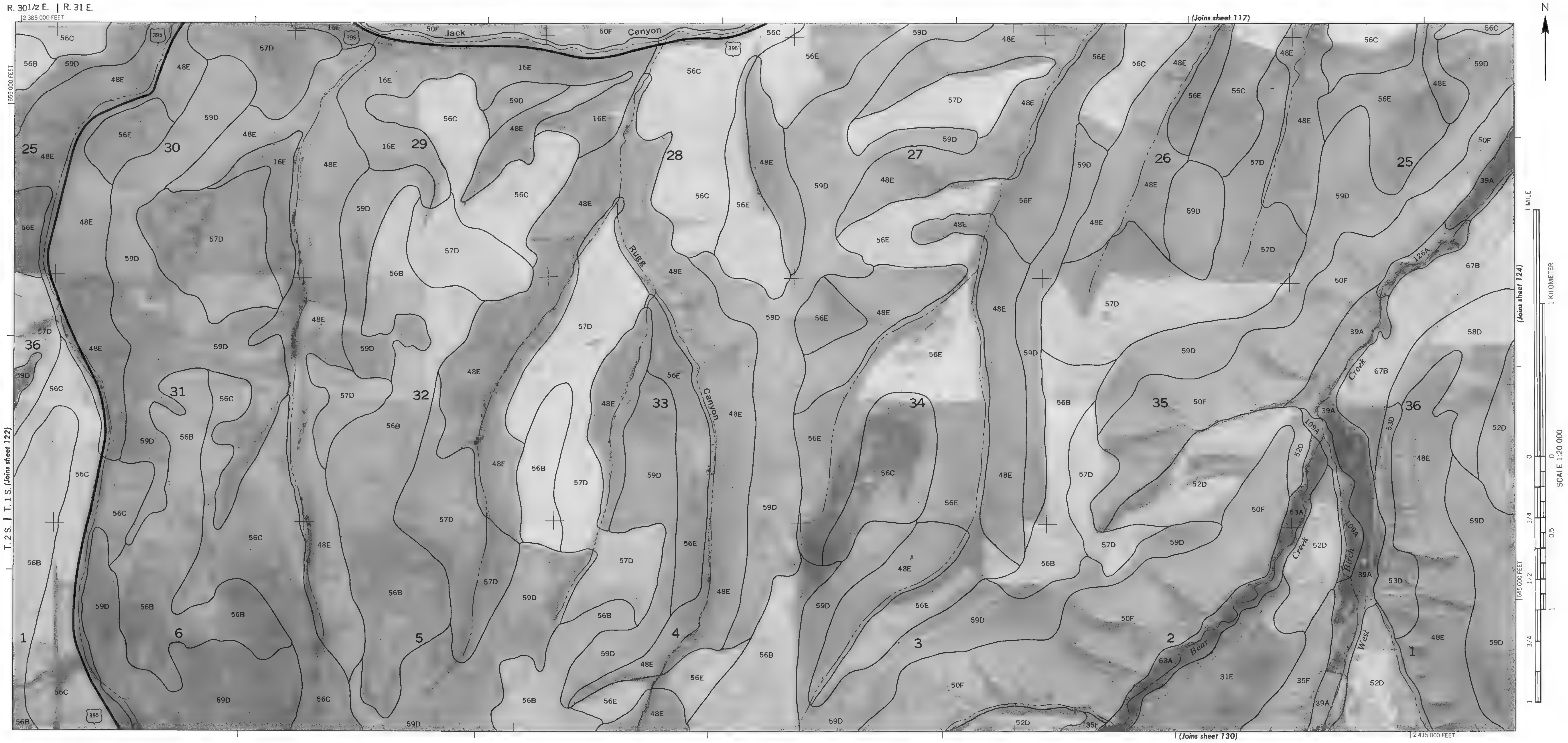


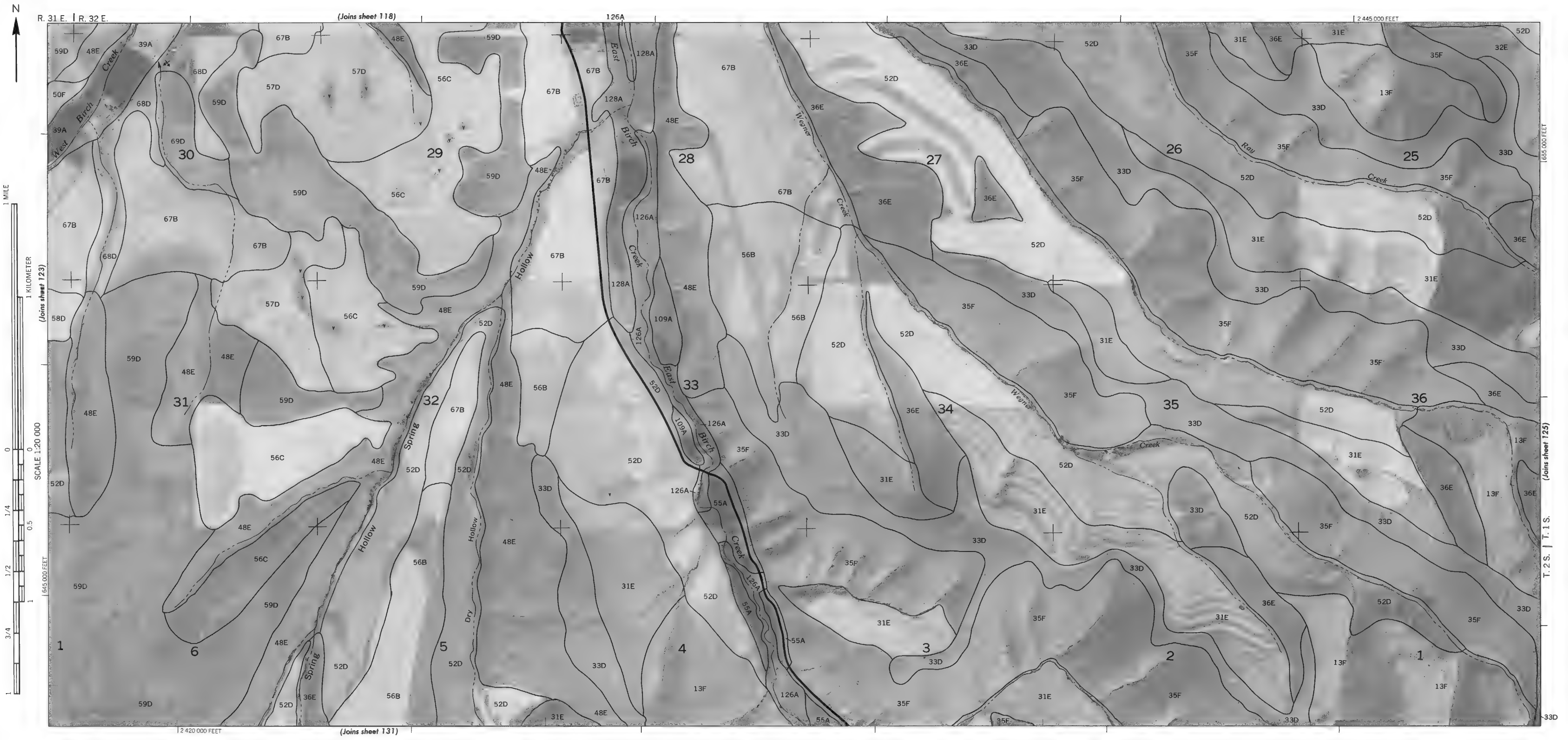
R. 32 E.
R. 33 E.
2 450 000 FEET
(Joins sheet 111)
(Joins sheet 125)
(Joins sheet 118)
(Joins sheet 120)
T. 1 S.
670 000 FEET
660 000 FEET
2 480 000 FEET
UMATILLA INDIAN RESERVATION
McKay Creek
Little McKay Creek
Stewart Creek
Gibson Gulch
Park Gulch
Axle Canyon
McDonald Canyon
Timene Canyon
Turrell Canyon
N
SCALE 1:20 000
1 MILE
1 KILOMETER

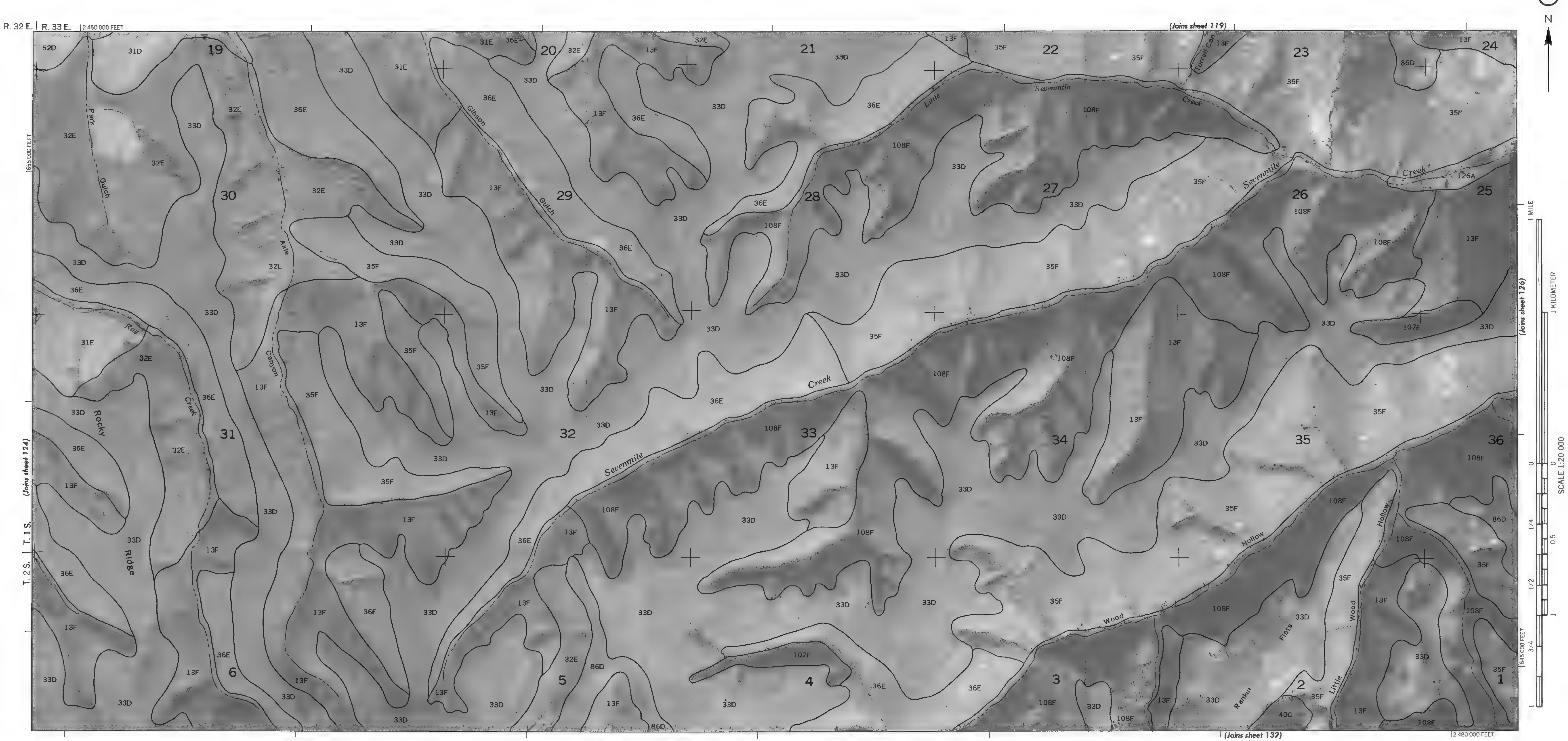

N
UMATILLA INDIAN RESERVATION
R. 33 E.
R. 34 E.
(Joins sheet 112)
(Joins sheet 119)
(Joins sheet 121)
(Joins sheet 126)
T. 1 S.
2 510 000 FEET
2 485 000 FEET
670 000 FEET
660 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
McKay Creek
Calamity Creek
Canyon
Lawler
Denson Canyon
Little Rail Creek
Green Spring Draw
Rail Creek
Red Spring Canyon
Coyote Canyon
Sevenmile Creek
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
35F
13F
126A
107E
86D
107F
108F
113D
112B
5C
44D
97C
100C
31E
31D

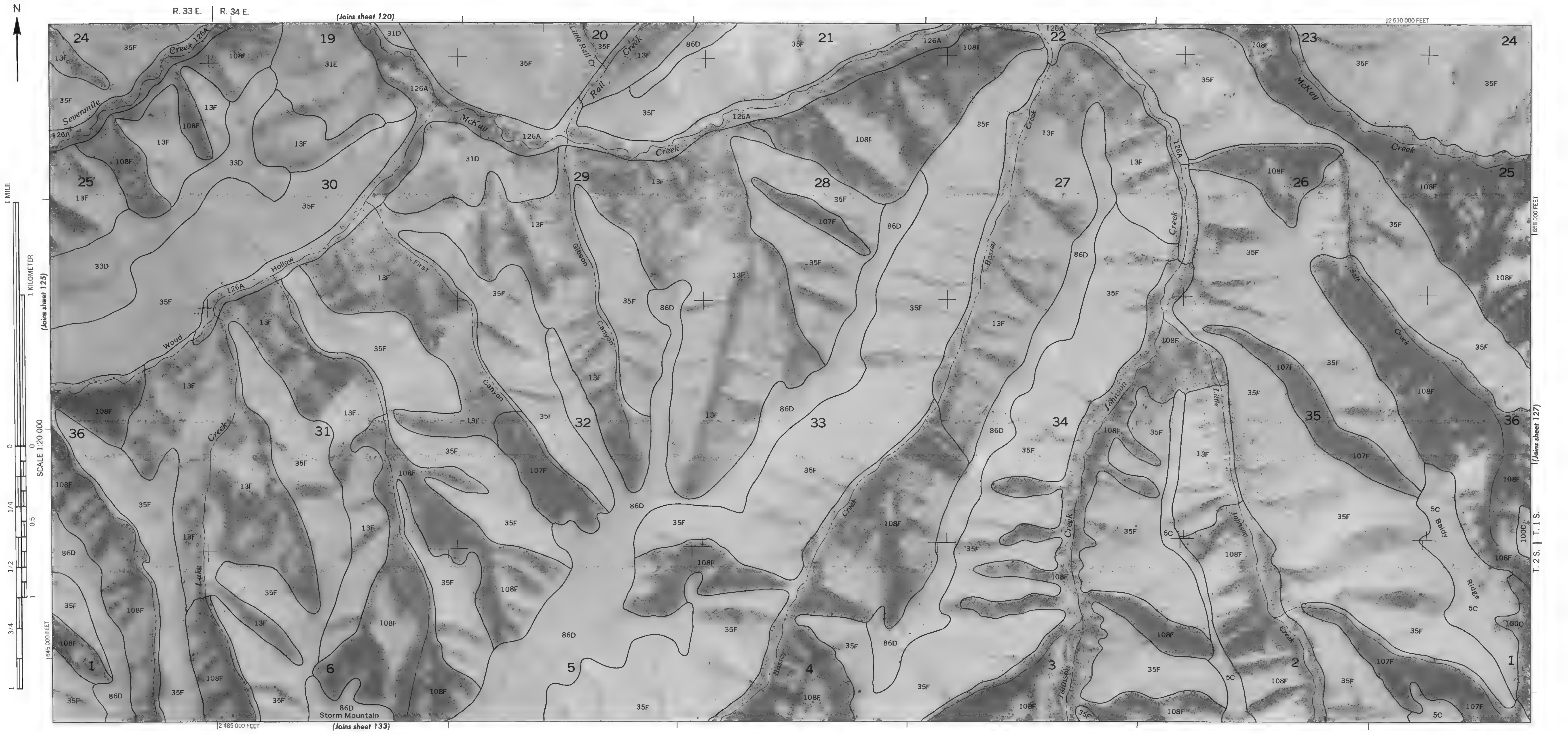

121
N
R. 34 E.
R. 35 E.
2 515 000 FEET
(Joins sheet 113)
(Joins sheet 127)
(Joins sheet 120)
(Joins inset, sheet 128)
T. 1 S.
670 000 FEET
665 000 FEET
2 545 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
Meacham Lake
Beaver Creek
Bell Cow Creek
Little Beaver Creek
Meacham Creek
Spring Canyon
Red Canyon
Coyote Canyon
Pad Creek
Sheep Creek
UNION PACIFIC
UMATILLA NAT. FOR.

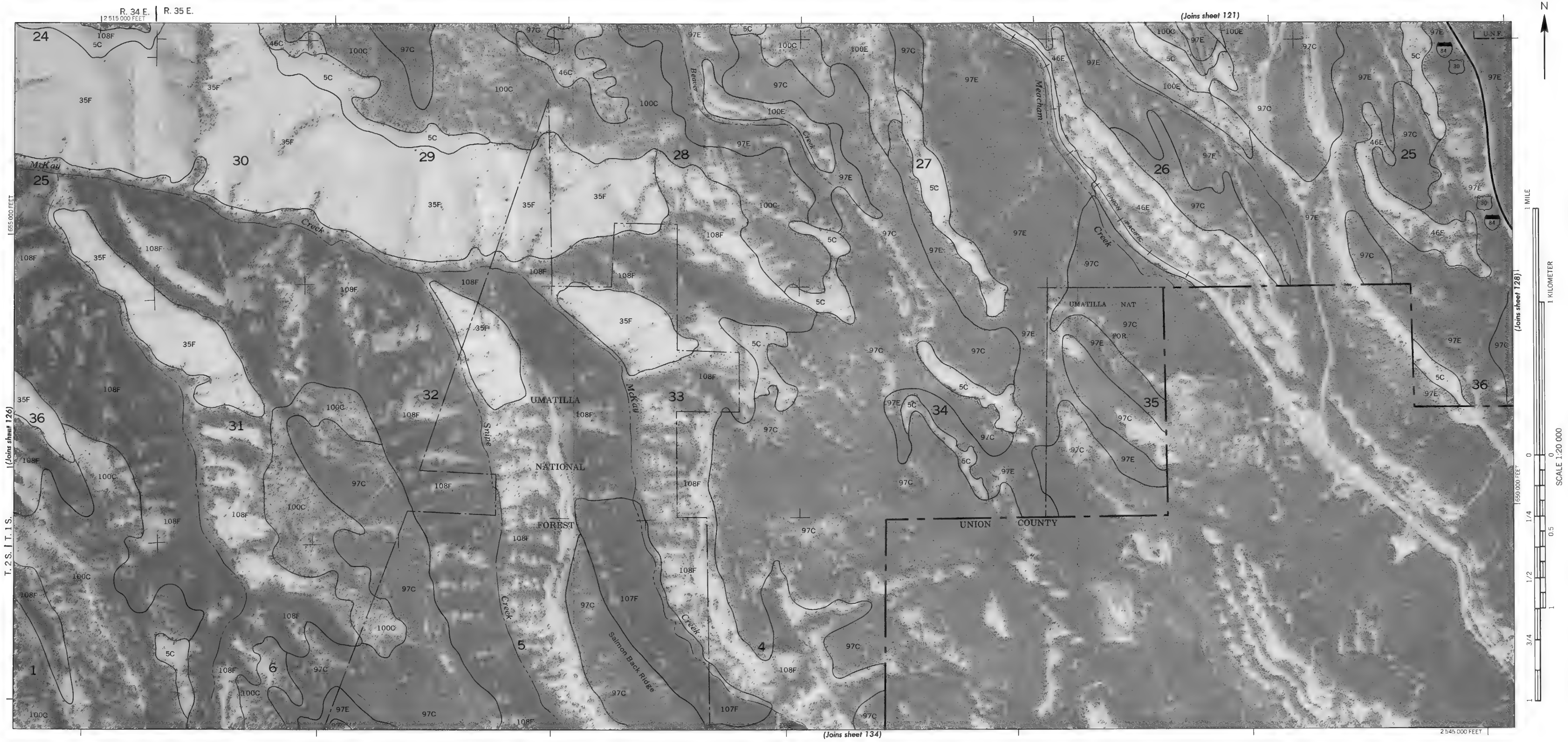

122
N
(Joins sheet 116)
(Joins sheet 129)
(Joins inset B, sheet 115)
(Joins sheet 123)
R. 30 E.
R. 30 1/2 E.
2 380 000 FEET
2 355 000 FEET
655 000 FEET
645 000 FEET
T. 1 S.
T. 2 S.
Dry Hog Hollow
Hog Hollow
Butter Creek
Vinson Canyon
Rancheree Canyon
Nelson Canyon
SCALE 1:20 000
1 MILE
1 KILOMETER
74

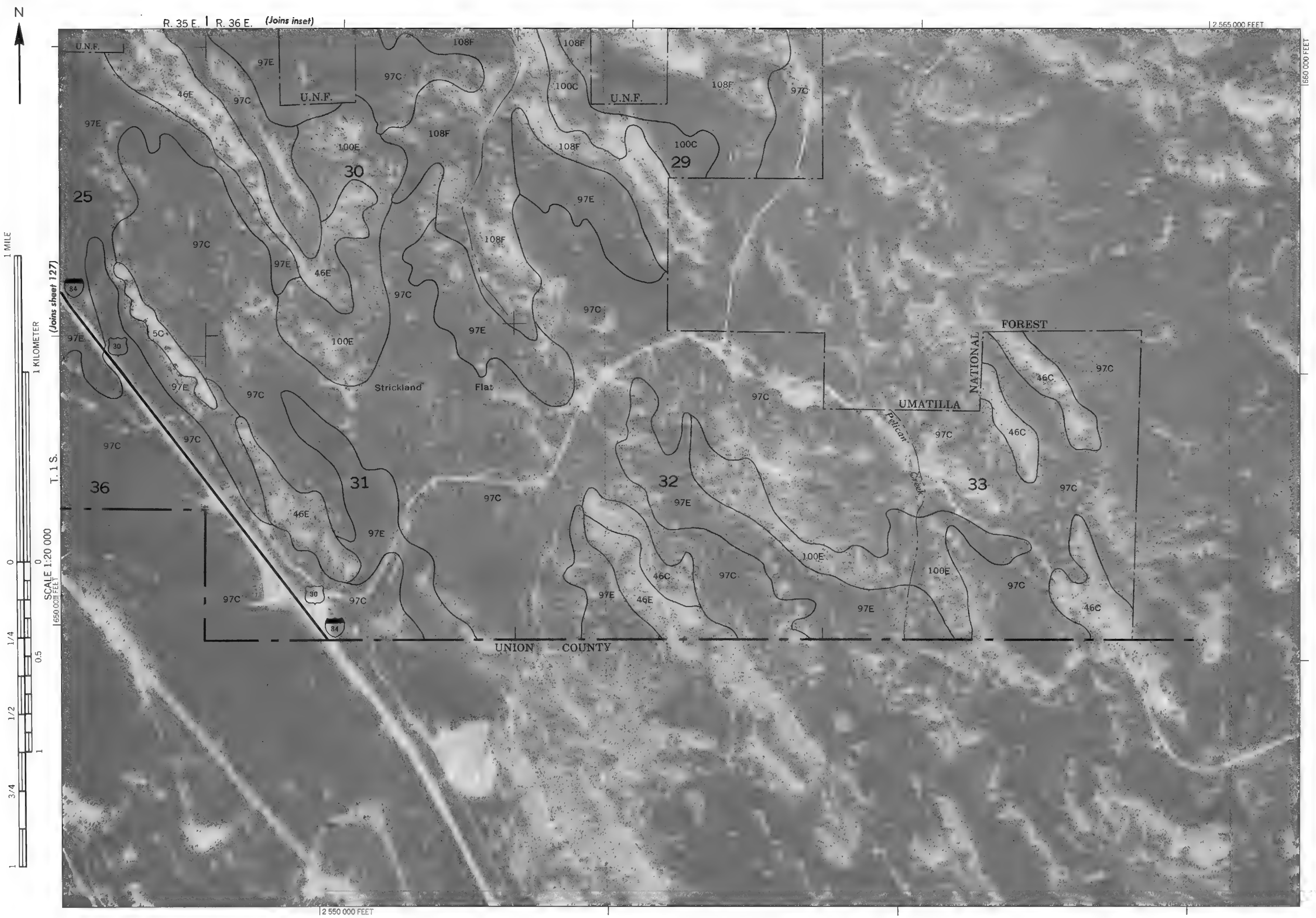

R. 30 1/2 E. | R. 31 E.
2 385 000 FEET
655 000 FEET
(Joins sheet 117)
(Joins sheet 124)
(Joins sheet 130)
(Joins sheet 122)
T. 1 S.
T. 2 S.
N
Jack Canyon
Rugg Canyon
Bear Creek
Birch Creek
West
645 000 FEET
2 415 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000

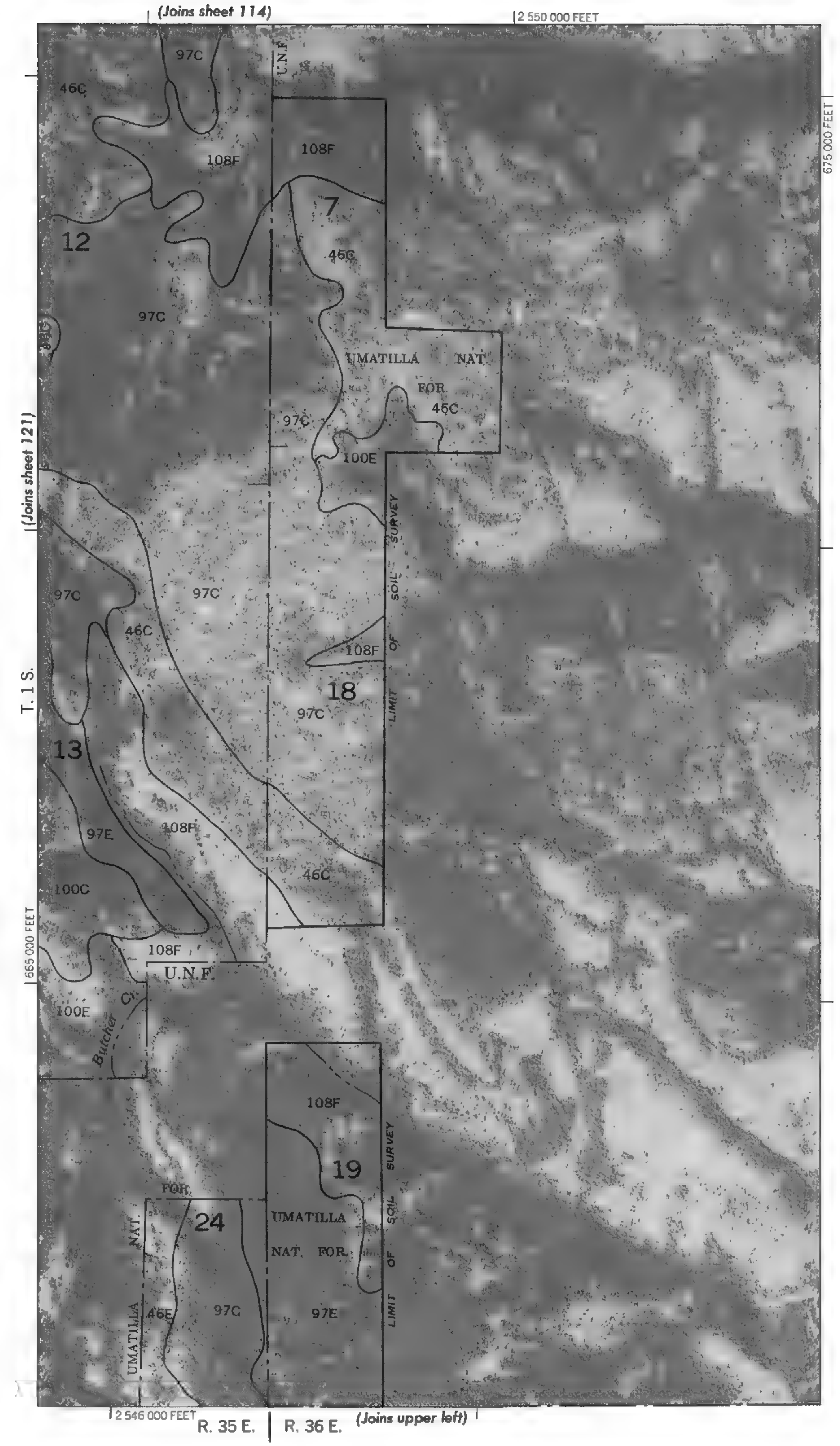

N
R. 31 E. | R. 32 E.
(Joins sheet 118)
2 445 000 FEET
665 000 FEET
(Joins sheet 125)
T. 2 S. | T. 1 S.
(Joins sheet 131)
2 420 000 FEET
(Joins sheet 123)
645 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
West Birch Creek
East Birch Creek
Spring Hollow
Dry Hollow
Wegner Creek
Ray Creek
25
26
27
28
29
30
31
32
33
34
35
36
1
2
3
4
5
6
59D
48E
39A
50F
68D
39A
69D
67B
68D
58D
52D
57D
56C
59D
48E
56B
109A
126A
128A
55A
36E
33D
31E
35F
13F
32E
13F
33D


125
N
R. 32 E. | R. 33 E.
2 450 000 FEET
(Joins sheet 119)
(Joins sheet 124)
(Joins sheet 126)
(Joins sheet 132)
2 480 000 FEET
655 000 FEET
645 000 FEET
T. 1 S.
T. 2 S.
Park Gulch
Axle Canyon
Gibson Gulch
Ray Creek
Rocky Ridge
Little Sevenmile Creek
Sevenmile Creek
Turrell Can
Wood Hollow
Hollow
Flats
Little Wood
Rankin
SCALE 1:20 000
1 MILE
1 KILOMETER

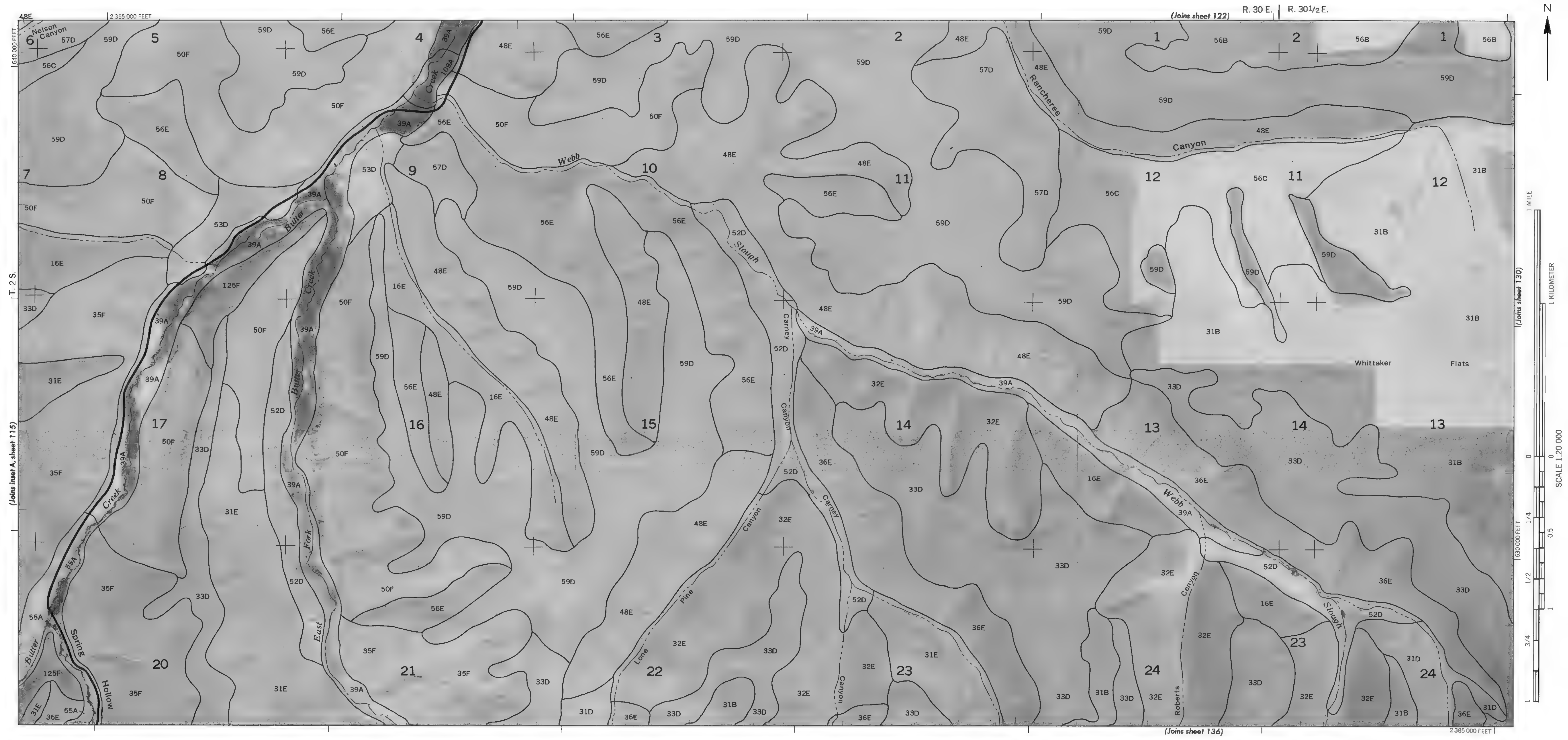

N
R. 33 E.
R. 34 E.
(Joins sheet 120)
(Joins sheet 125)
(Joins sheet 127)
(Joins sheet 133)
2 510 000 FEET
2 485 000 FEET
651 000 FEET
645 000 FEET
T. 2 S.
T. 1 S.
SCALE 1:20 000
1 MILE
1 KILOMETER
Sevenmile Creek
McKay Creek
Little Rail Cr
Rail Creek
Wood Hollow Creek
First Canyon
Gibson Canyon
Bassey Creek
Johnson Creek
Little Johnson Creek
Salt Creek
Lake Creek
Baldy Ridge
Storm Mountain


127
N
R. 34 E.
R. 35 E.
2 515 000 FEET
(Joins sheet 121)
(Joins sheet 128)
(Joins sheet 126)
(Joins sheet 134)
655 000 FEET
650 000 FEET
2 545 000 FEET
T. 2 S. | T. 1 S.
U.N.F.
McKay Creek
Beaver Creek
Meacham Creek
Snipe Creek
Salmon Back Ridge
UNION PACIFIC
UMATILLA NATIONAL FOREST
UMATILLA NAT FOR.
UNION COUNTY
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5

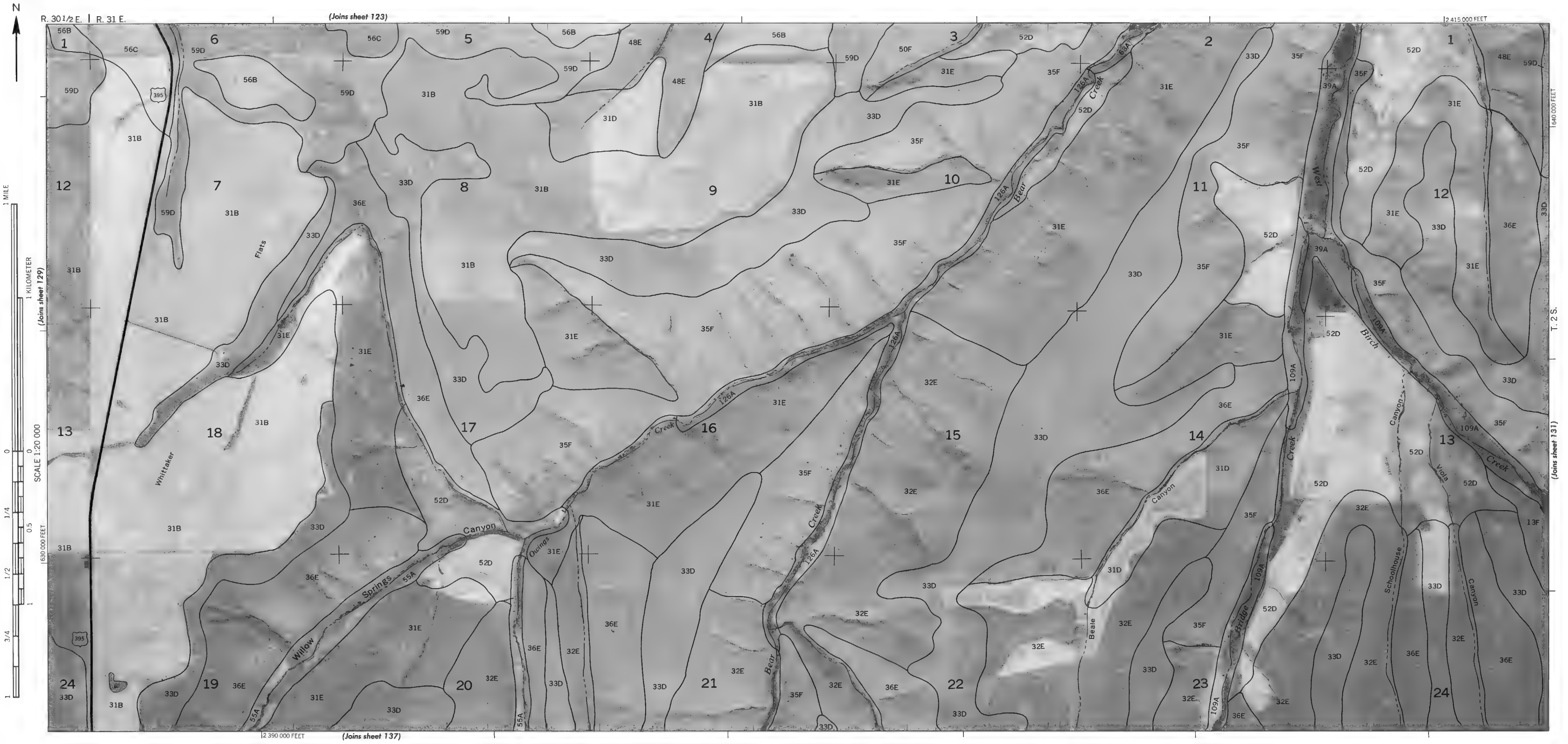


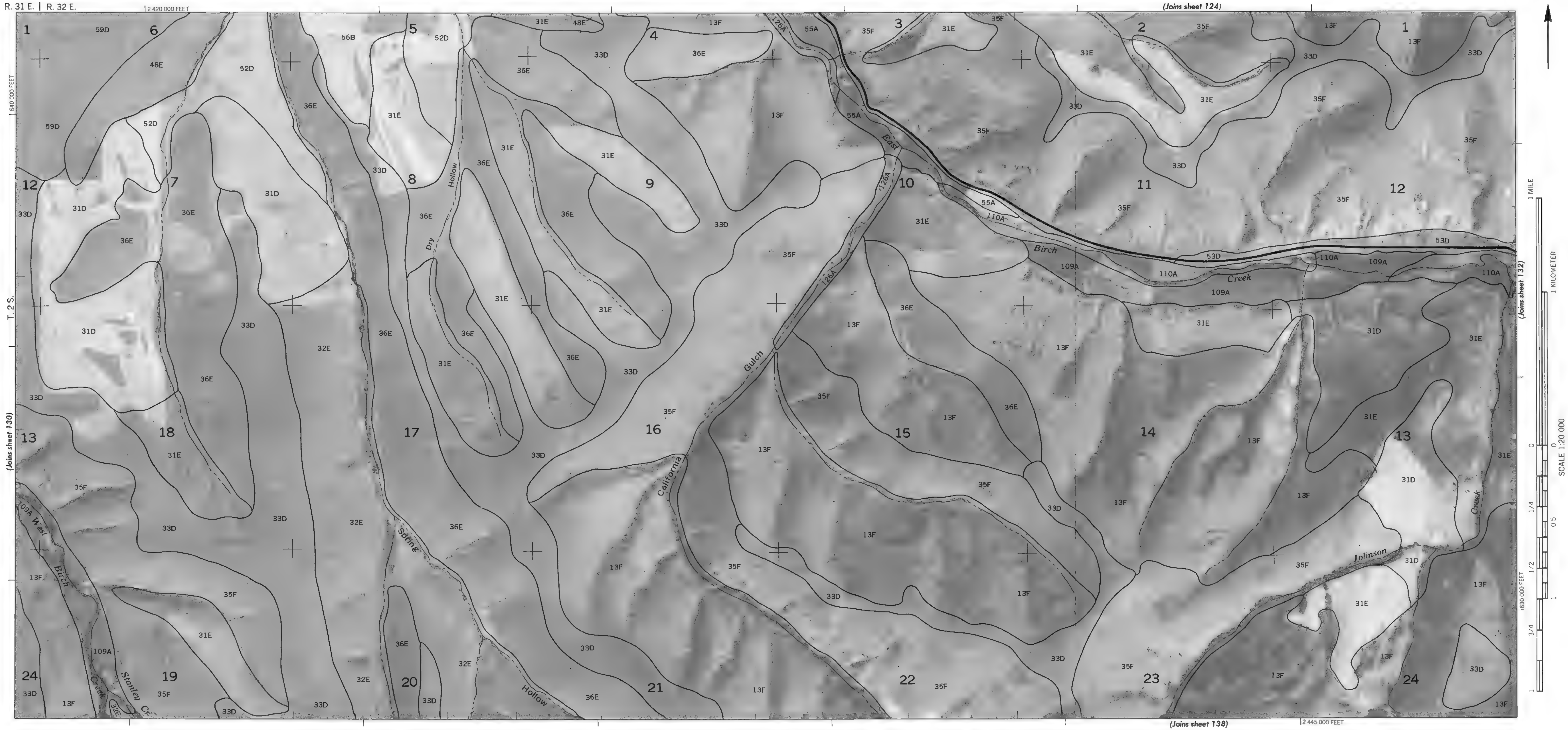


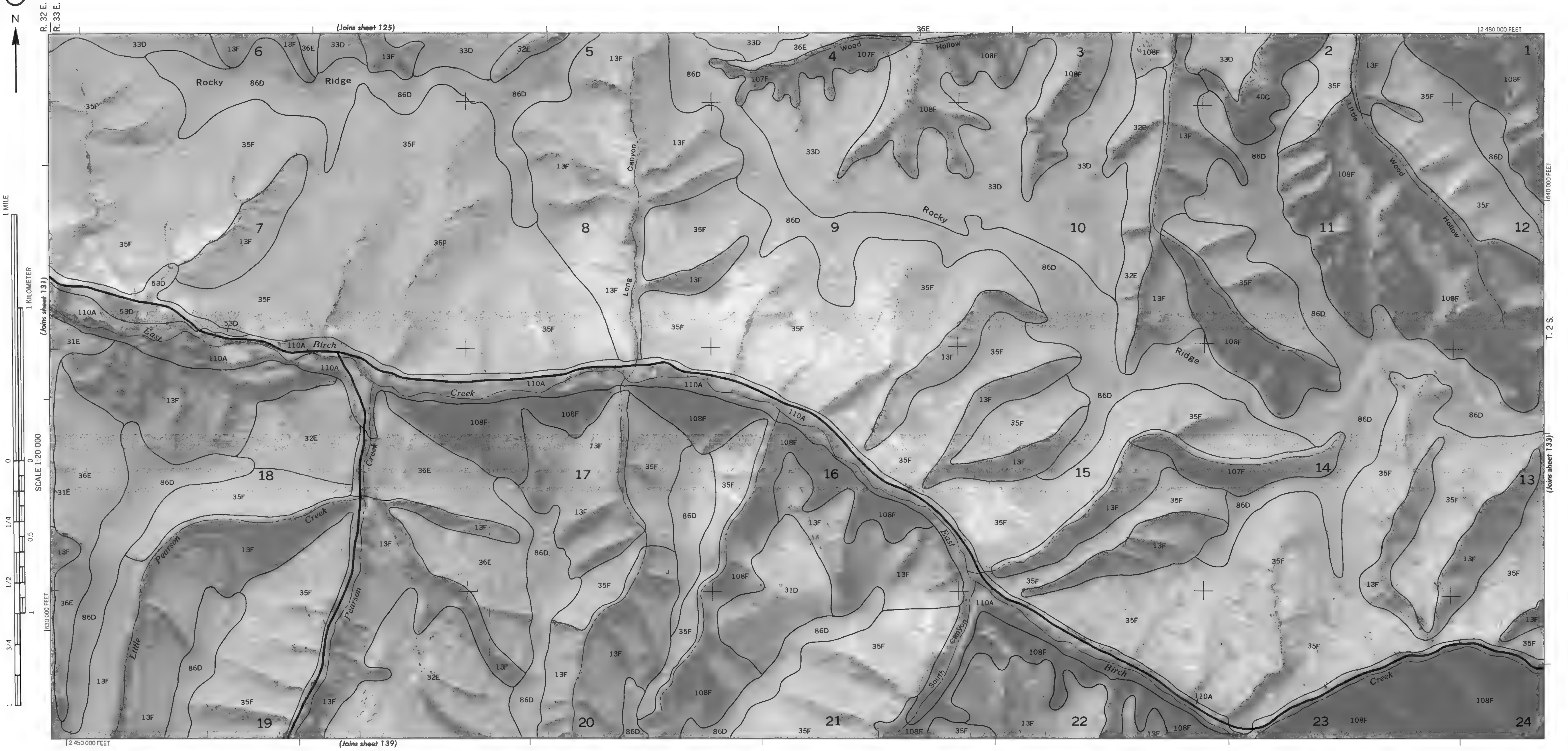
4000 AND 5000-FOOT GRID TICKS

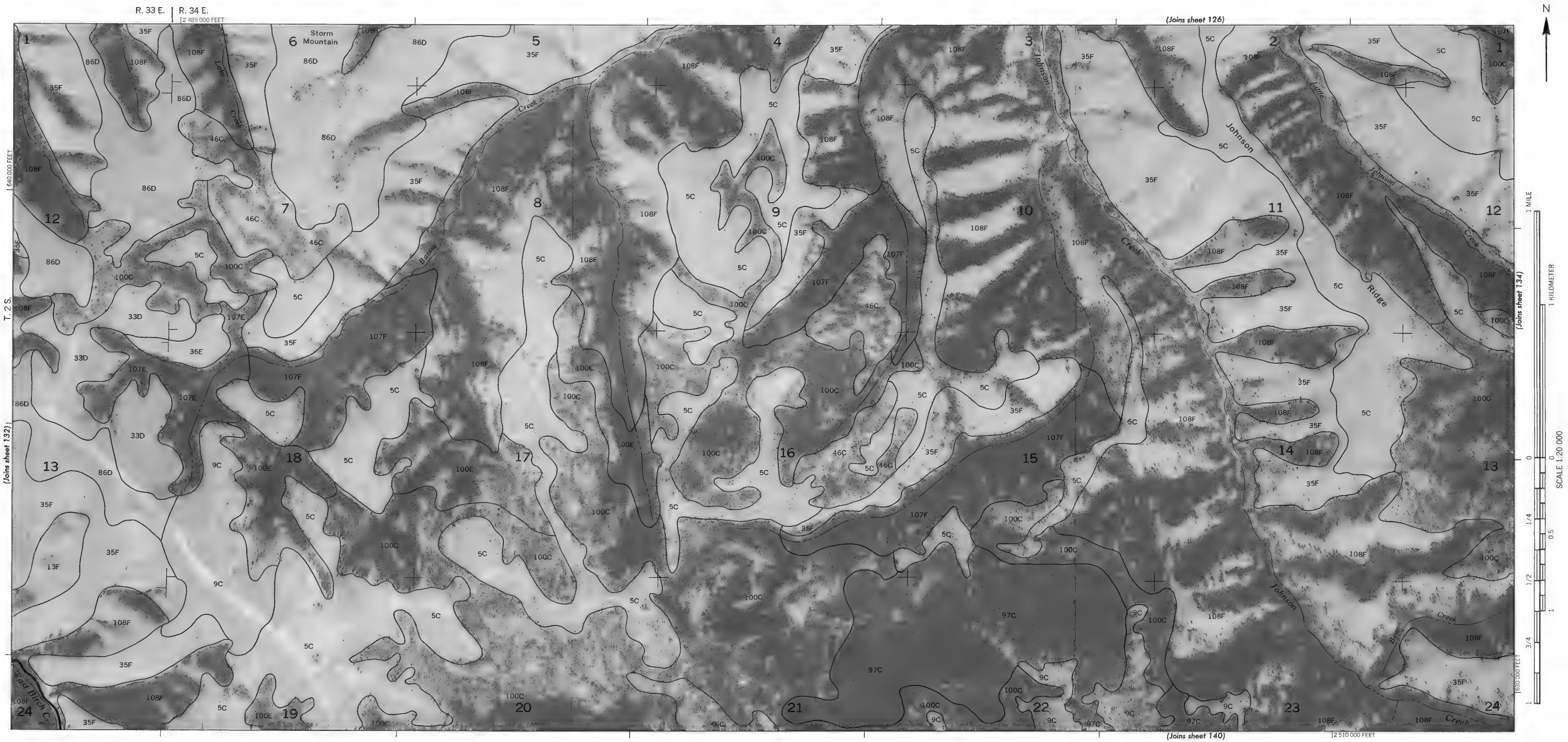

129
N
(Joins sheet 122)
R. 30 E. | R. 30 1/2 E.
2 355 000 FEET
640 000 FEET
T. 2 S.
(Joins inset A, sheet 115)
(Joins sheet 130)
(Joins sheet 136)
2 385 000 FEET
630 000 FEET
Nelson Canyon
Butter Creek
East Fork Butter Creek
Spring Hollow
Webb Slough
Rancheree Canyon
Carney Canyon
Lone Pine Canyon
Roberts Canyon
Whittaker Flats
1 MILE
1 KILOMETER
SCALE 1:20 000

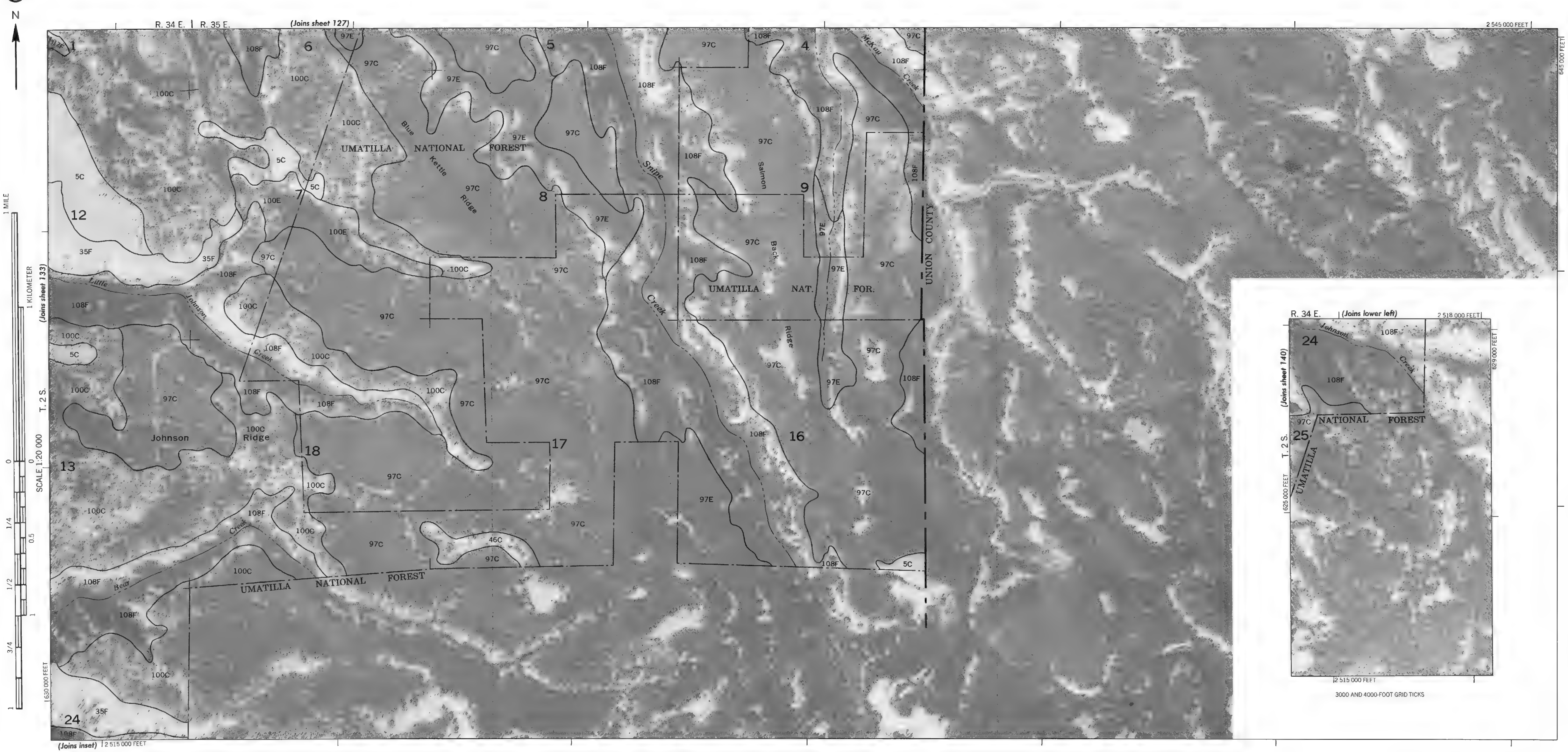
UMATILLA COUNTY AREA, OREGON — SHEET NUMBER 130



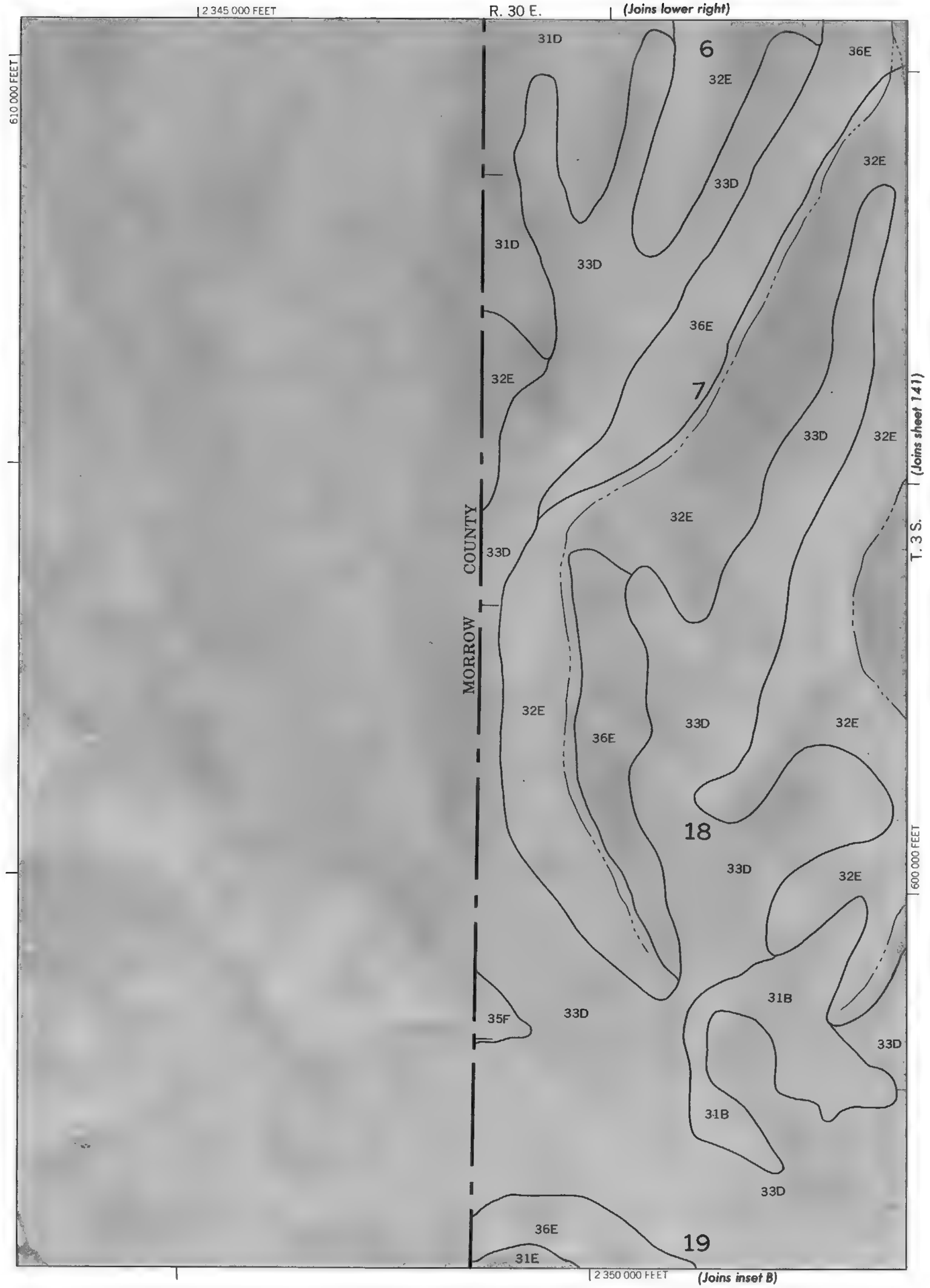

R. 31 E. | R. 32 E.
2 420 000 FEET
(Joins sheet 124)
640 000 FEET
T. 2 S.
(Joins sheet 130)
(Joins sheet 132)
(Joins sheet 138)
2 445 000 FEET
630 000 FEET
N
1 MILE
1 KILOMETER
SCALE 1:20 000
East
Birch
Creek
Dry
Hollow
Gulch
California
Spring
Hollow
West
Birch
Creek
Stanley Cr
Johnson
Creek


132
N
R. 32 E.
R. 33 E.
(Joins sheet 125)
(Joins sheet 131)
(Joins sheet 133)
(Joins sheet 139)
2 480 000 FEET
2 450 000 FEET
640 000 FEET
630 000 FEET
T. 2 S.
SCALE 1:20 000
1 MILE
1 KILOMETER
Rocky Ridge
Long Canyon
Wood Hollow
Little Wood Hollow
Rocky Ridge
East Birch Creek
Pearson Creek
Little Pearson Creek
South Canyon
Birch Creek

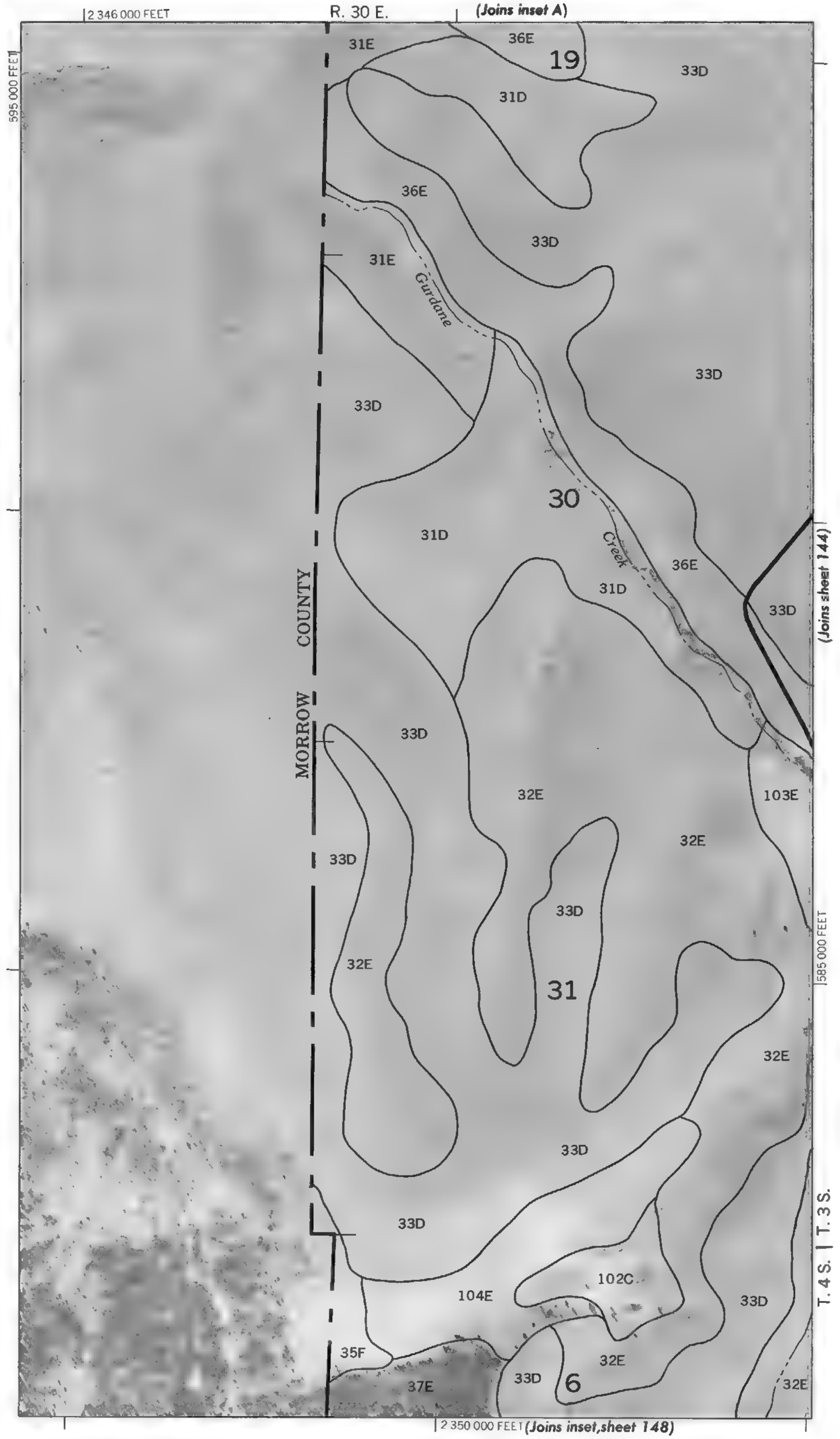

133
N
R. 33 E.
R. 34 E.
2 485 000 FEET
(Joins sheet 126)
(Joins sheet 134)
(Joins sheet 140)
(Joins sheet 132)
T. 2 S.
640 000 FEET
630 000 FEET
2 510 000 FEET
Storm Mountain
Lane Creek
Bassey Creek
Johnson Creek
Little Johnson Creek
Johnson Ridge
Bear Creek
East Birch Cr.
SCALE 1:20 000
1 MILE
1 KILOMETER
3/4
1/2
1/4
0
0.5
1

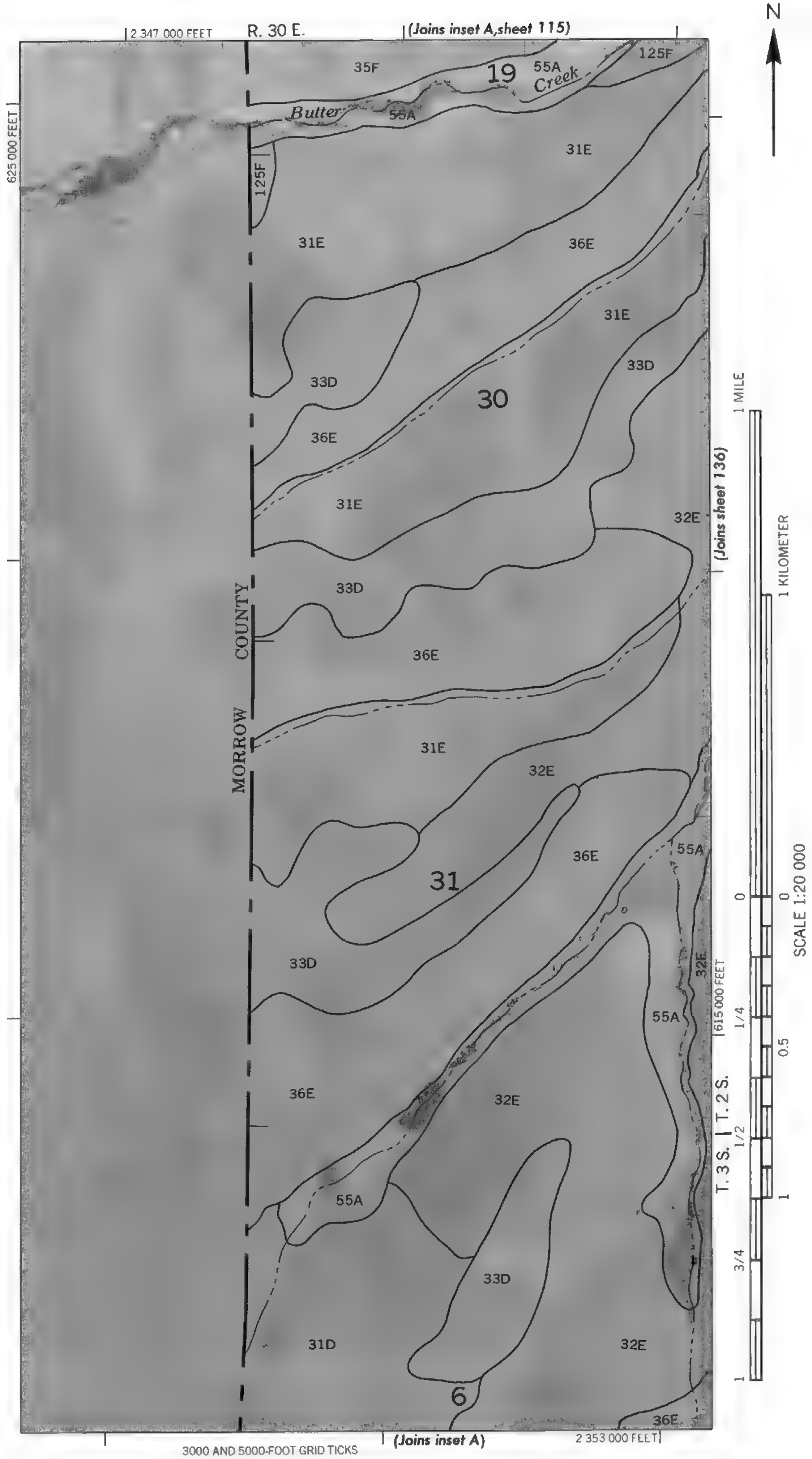

134
N
R. 34 E.
R. 35 E.
(Joins sheet 127)
(Joins sheet 133)
(Joins inset)
2 515 000 FEET
2 545 000 FEET
645 000 FEET
630 000 FEET
T. 2 S.
SCALE 1:20 000
1 MILE
1 KILOMETER
UMATILLA NATIONAL FOREST
UMATILLA NAT. FOR.
UNION COUNTY
Blue Kettle Ridge
Johnson Ridge
Salmon Back Ridge
Snipe Creek
McKay Creek
Little Johnson Creek
Bear Creek
R. 34 E.
(Joins lower left)
2 518 000 FEET
629 000 FEET
625 000 FEET
2 515 000 FEET
(Joins sheet 140)
3000 AND 4000-FOOT GRID TICKS

INSET A



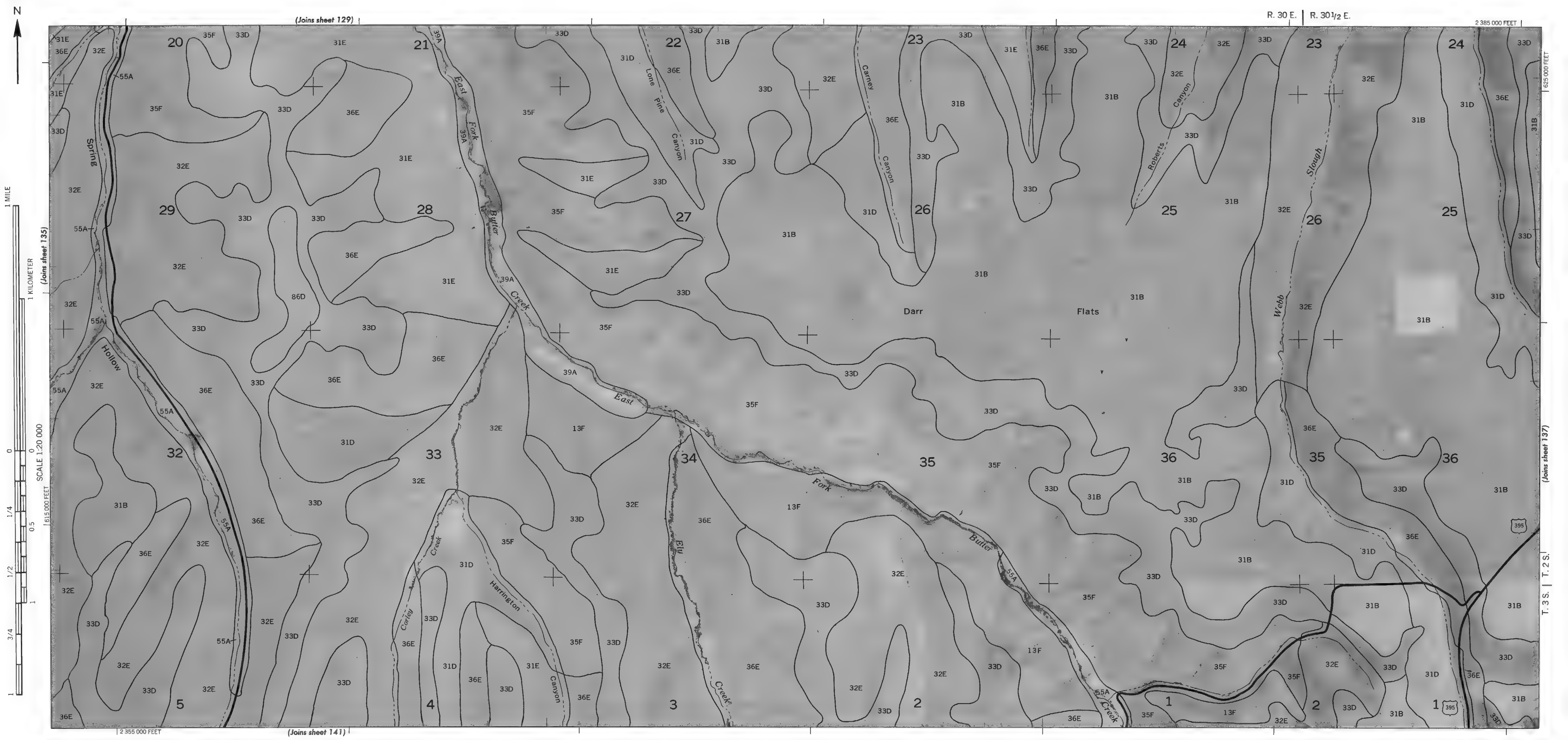
INSET B

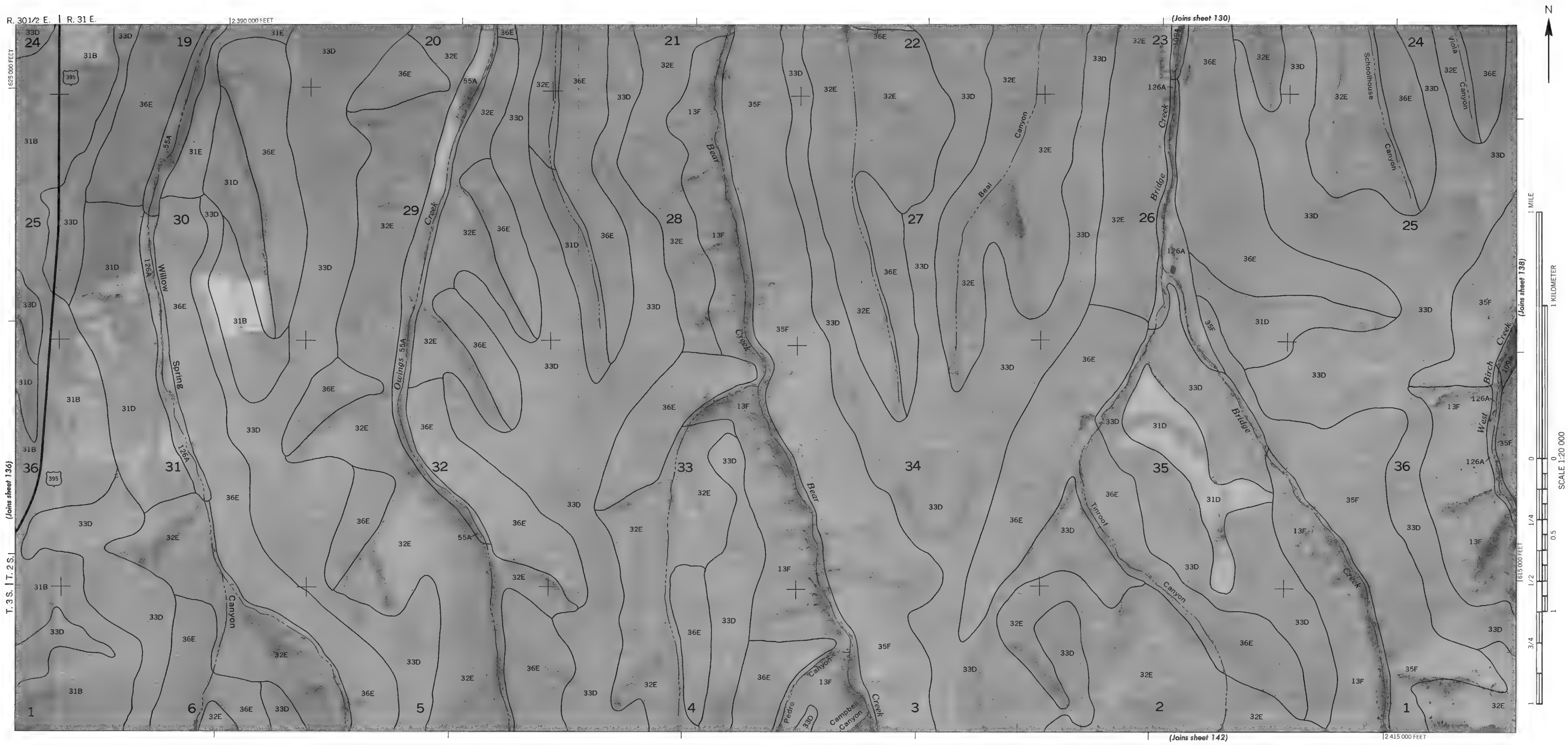


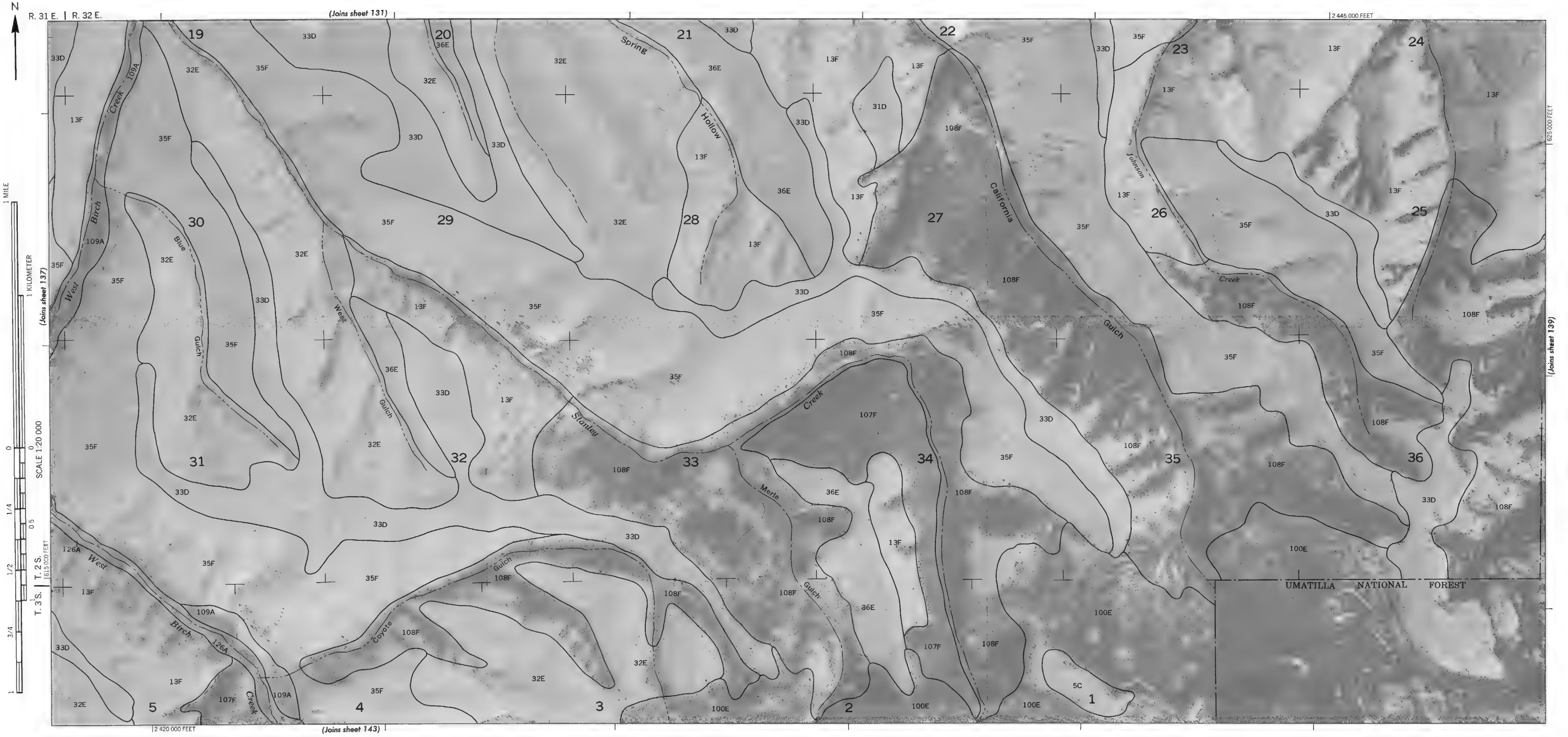


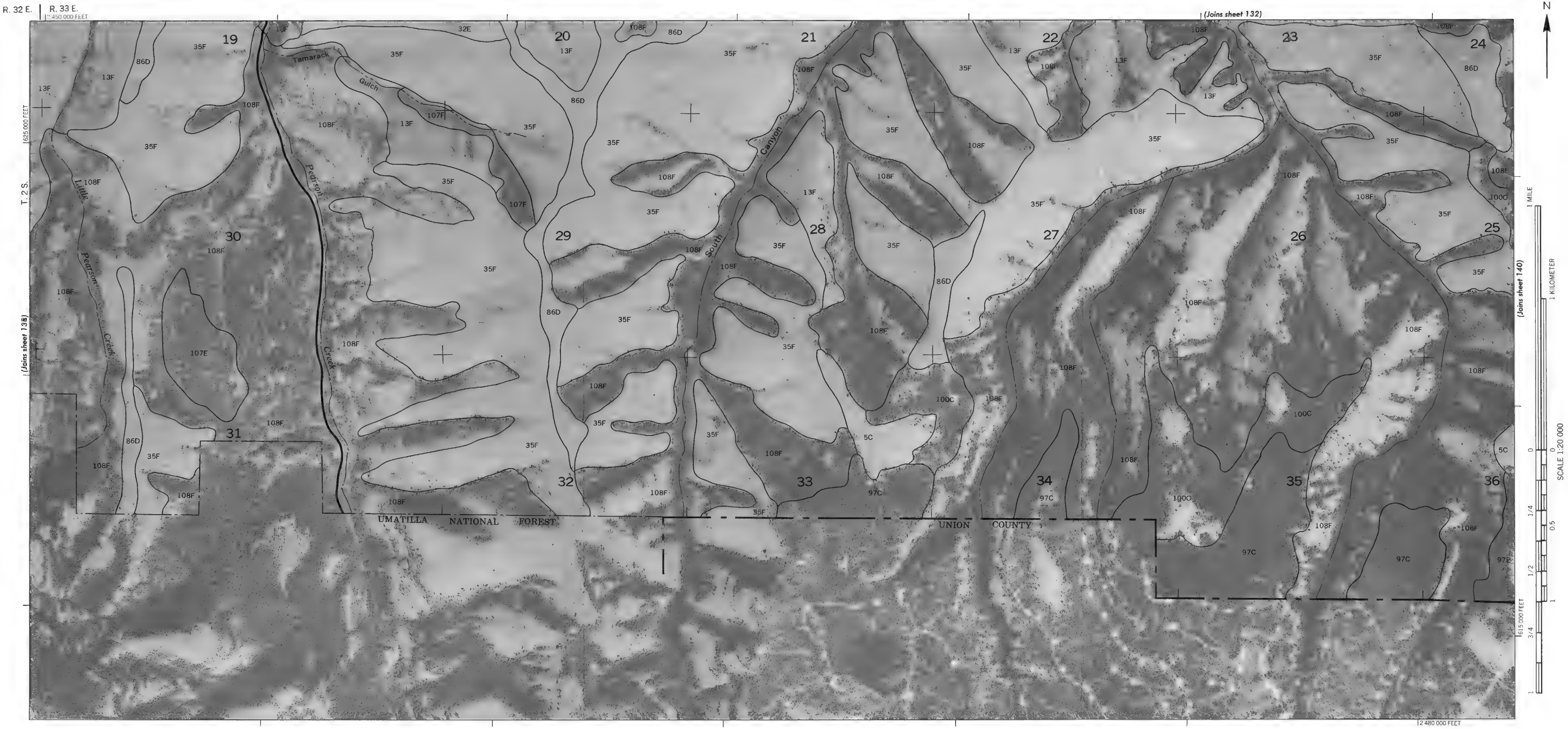
4000 AND 5000-FOOT GRID TICKS

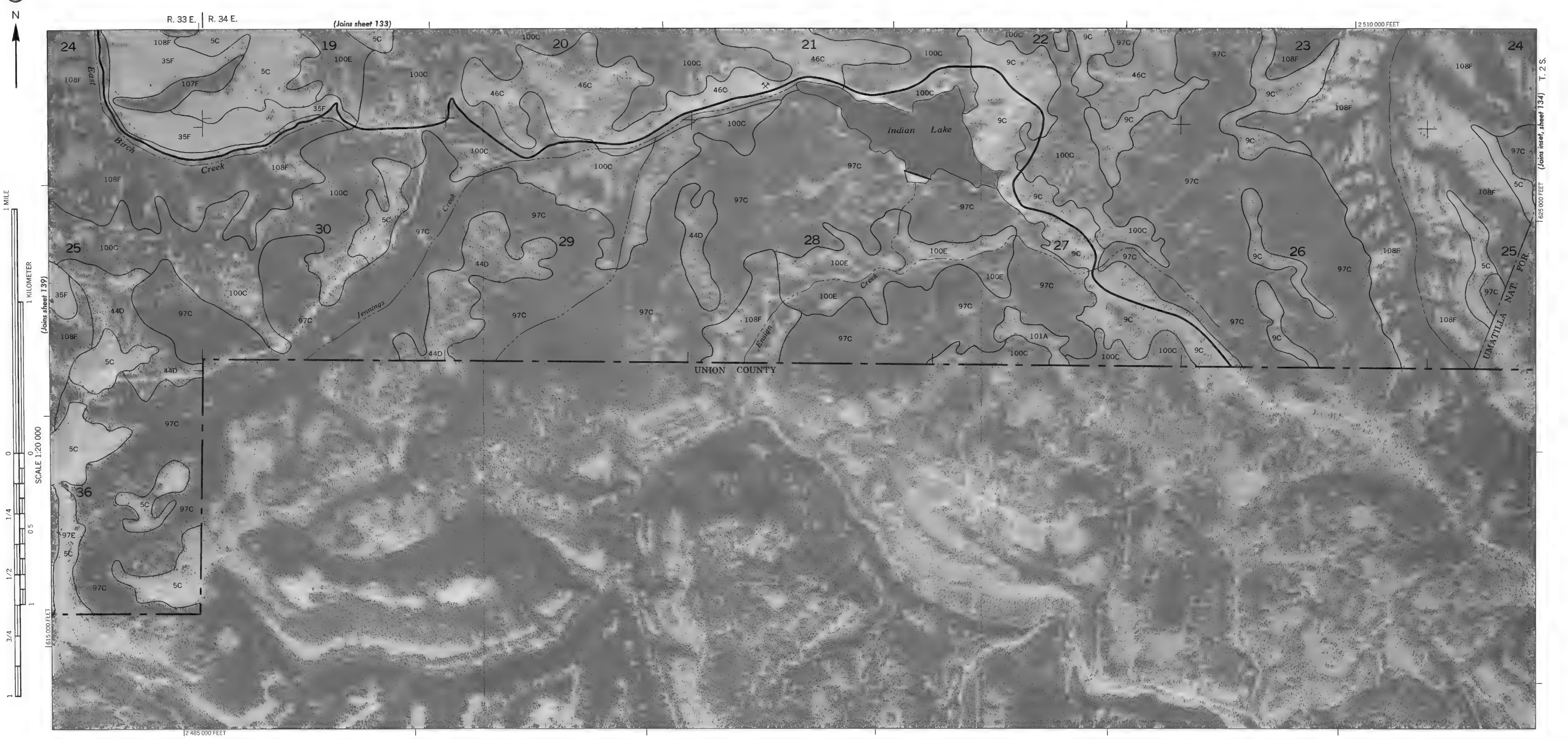
3000 AND 5000-FOOT GRID TICKS

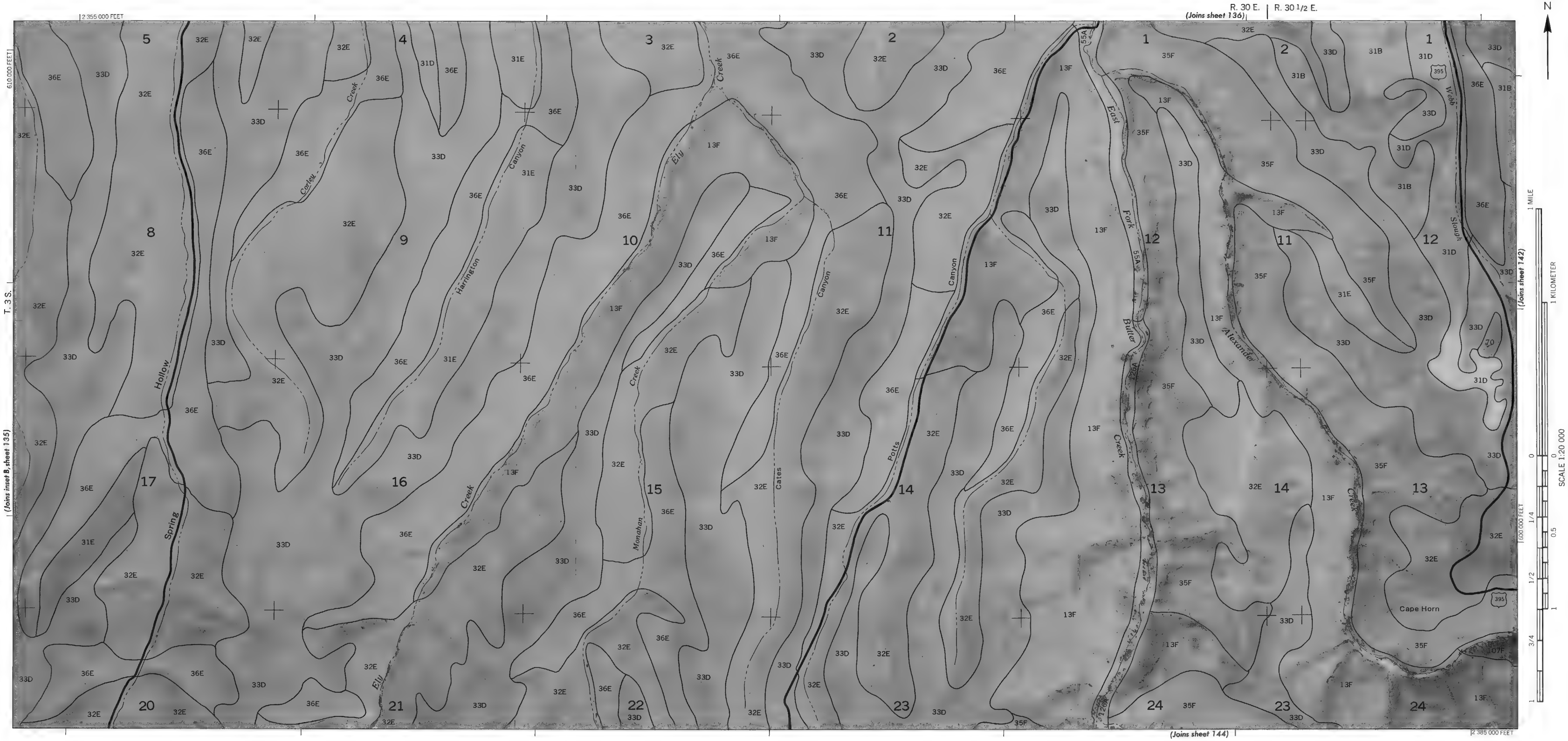

N
R. 30 E. | R. 30 1/2 E.
(Joins sheet 129)
(Joins sheet 135)
(Joins sheet 137)
(Joins sheet 141)
T. 3 S. | T. 2 S.
2 355 000 FEET
2 385 000 FEET
615 000 FEET
625 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
Darr
Flats
Spring
Hollow
East
Fork
Butter
Creek
Lone
Pine
Canyon
Carney
Canyon
Roberts
Canyon
Webb
Slough
Ely
Creek
Corley
Creek
Harrington
Canyon
395

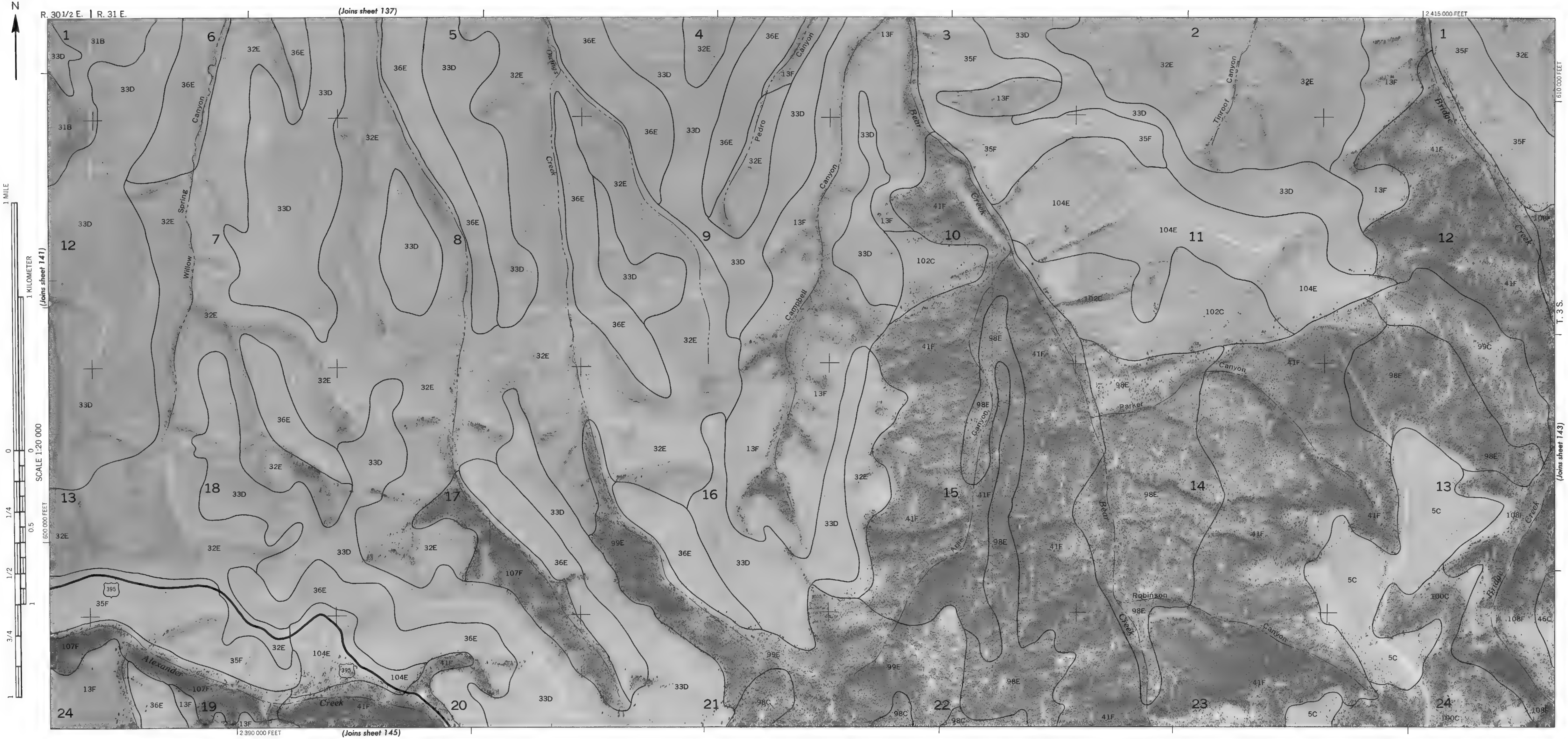

R. 30 1/2 E.
R. 31 E.
2 390 000 FEET
(Joins sheet 130)
N
625 000 FEET
T. 3 S.
T. 2 S.
(Joins sheet 136)
(Joins sheet 138)
615 000 FEET
(Joins sheet 142)
2 415 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
395
Willow
Spring
Canyon
Owings
Creek
Bear
Creek
Pedro
Canyon
Campbell
Canyon
Beal
Canyon
Bridge
Creek
Tinroof
Canyon
Schoolhouse
Canyon
Viola
Canyon
West
Birch
Creek
24
19
20
21
22
23
25
30
29
28
27
26
36
31
32
33
34
35
1
6
5
4
3
2

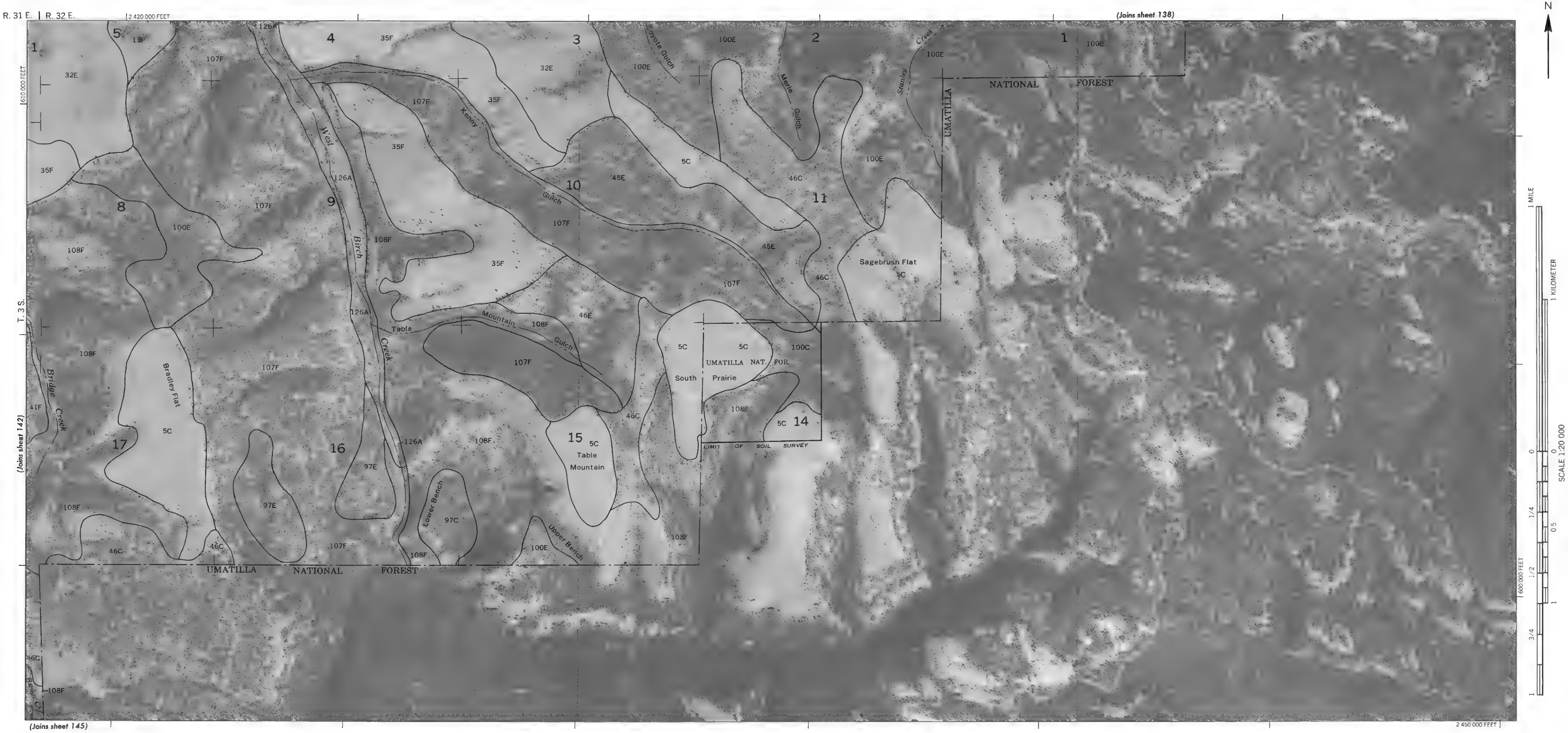

N
R. 31 E. | R. 32 E.
(Joins sheet 131)
(Joins sheet 137)
(Joins sheet 139)
(Joins sheet 143)
2 420 000 FEET
2 445 000 FEET
625 000 FEET
615 000 FEET
T. 2 S.
T. 3 S.
1 MILE
1 KILOMETER
SCALE 1:20 000
UMATILLA NATIONAL FOREST
West Birch Creek
Blue Gulch
West Gulch
Spring Hollow
California Gulch
Johnson Creek
Stanley Creek
Merle Gulch
Coyote Gulch
Birch Creek

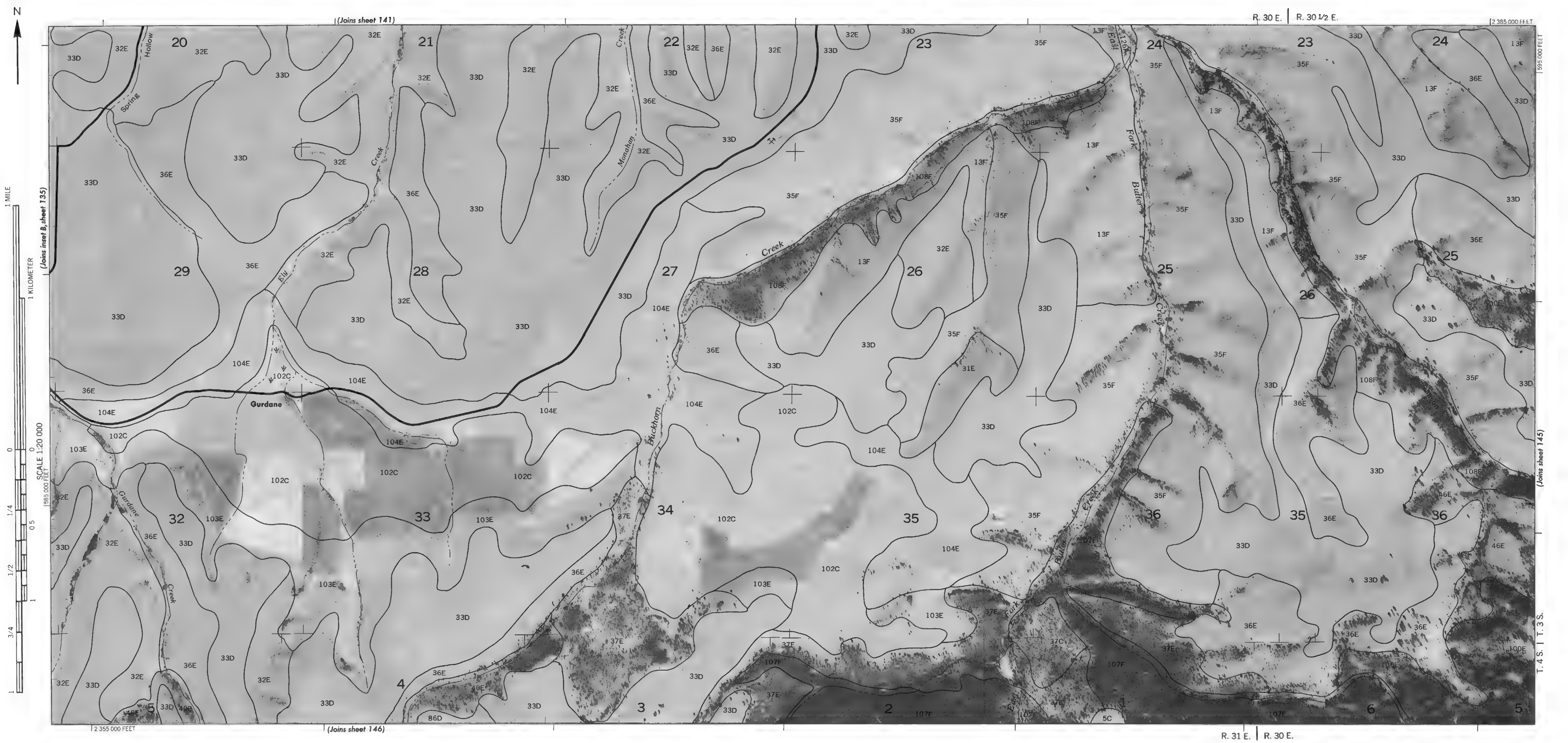

R. 32 E.
R. 33 E.
2 450 000 FEET
(Joins sheet 132)
(Joins sheet 138)
(Joins sheet 140)
625 000 FEET
615 000 FEET
2 480 000 FEET
T. 2 S.
N
Tamarack Gulch
Pearson Creek
Little Pearson Creek
South Canyon
UMATILLA NATIONAL FOREST
UNION COUNTY
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
13F
32E
35F
86D
108F
107F
107E
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
100C
5C
97C

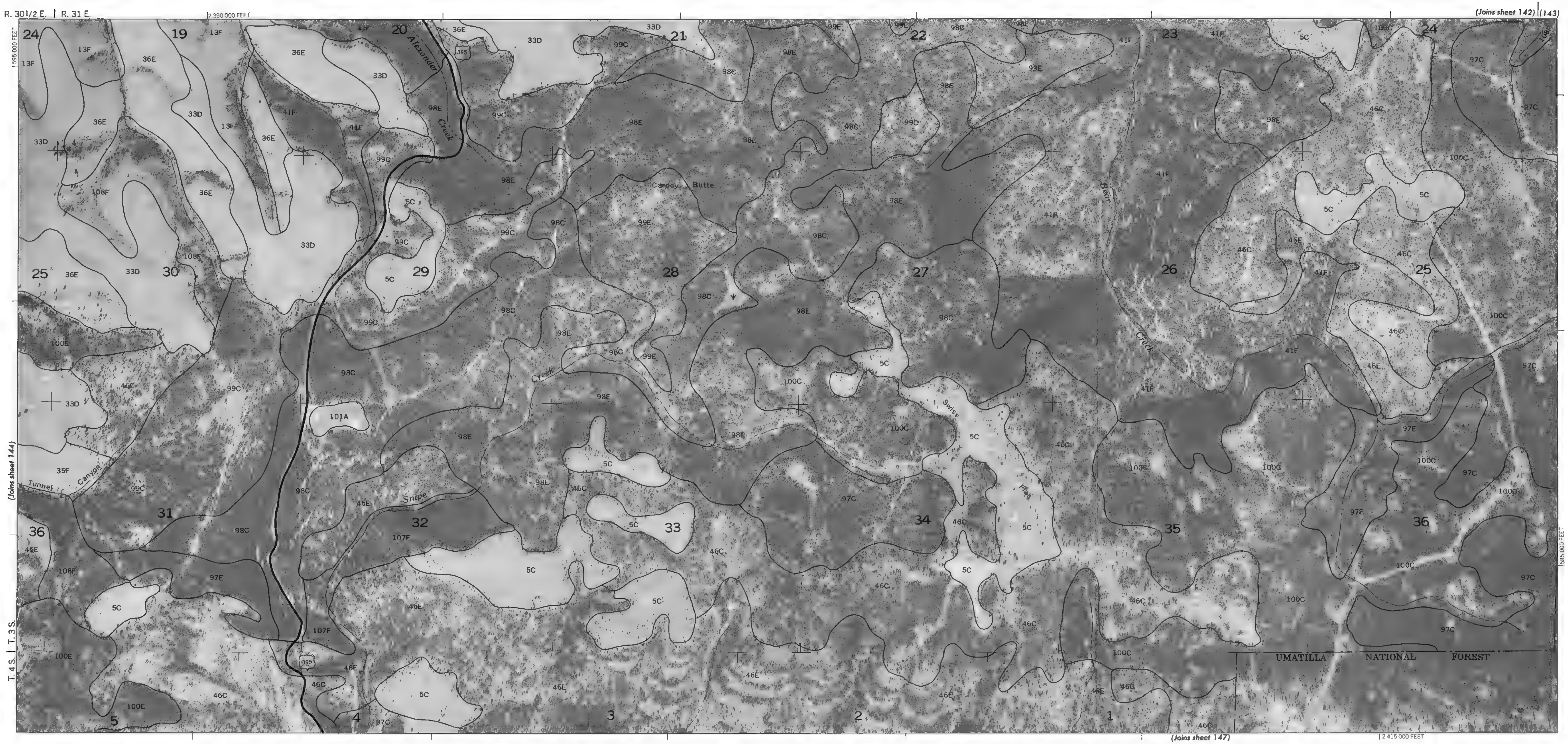

N
R. 33 E.
R. 34 E.
(Joins sheet 133)
2 510 000 FEET
T. 2 S.
(Joins inset, sheet 134)
625 000 FEET
(Joins sheet 139)
615 000 FEET
2 485 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
East Birch Creek
Jennings Creek
Ensign Creek
Indian Lake
UNION COUNTY
UMATILLA NAT. FOR.
19
20
21
22
23
24
25
26
27
28
29
30
36
5C
9C
35F
44D
46C
97C
97E
100C
100E
101A
107F
108F

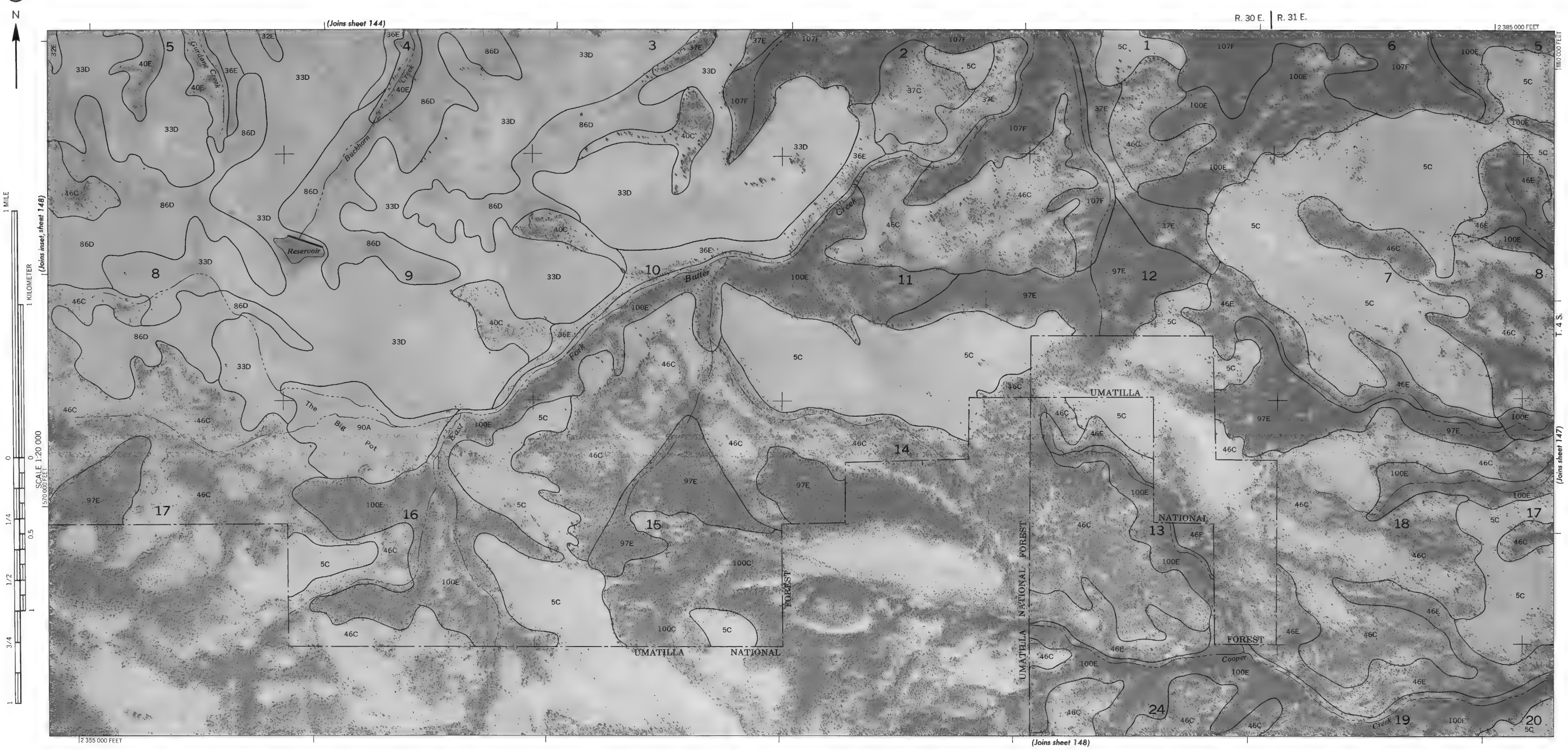

R. 30 E.
R. 30 1/2 E.
(Joins sheet 136)
(Joins sheet 142)
(Joins sheet 144)
(Joins inset B, sheet 135)
T. 3 S.
2 355 000 FEET
2 385 000 FEET
610 000 FEET
600 000 FEET
N
1 MILE
1 KILOMETER
SCALE 1:20 000
Hollow
Spring
Corley Creek
Harrington Canyon
Ely Creek
Monahan Creek
Cates Canyon
Potts Canyon
East Fork Butter Creek
Alexander Creek
Webb Slough
Cape Horn
395

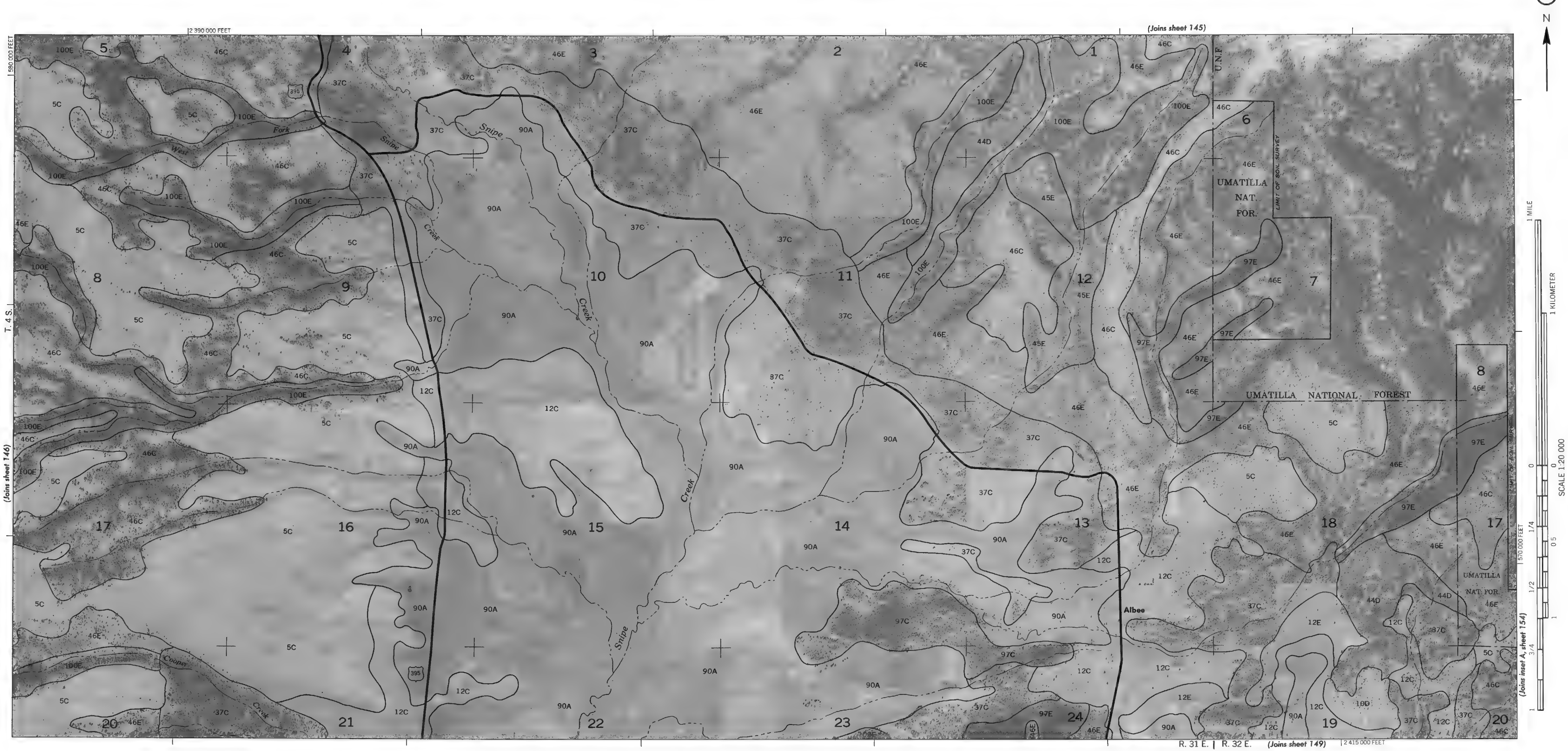

N
R. 30 1/2 E. | R. 31 E.
(Joins sheet 137)
2 415 000 FEET
610 000 FEET
T. 3 S.
(Joins sheet 143)
(Joins sheet 141)
(Joins sheet 145)
2 390 000 FEET
600 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
Spring Canyon
Willow
Canyon
Creek
Pedro Canyon
Campbell Canyon
Bear Creek
Tiproot Canyon
Bridge Creek
Parker Canyon
Robinson Canyon
Alexander Creek
395
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
31B
33D
32E
36E
35F
13F
41F
98E
99E
98C
102C
104E
107F
108F
5C
99C
100C
46C

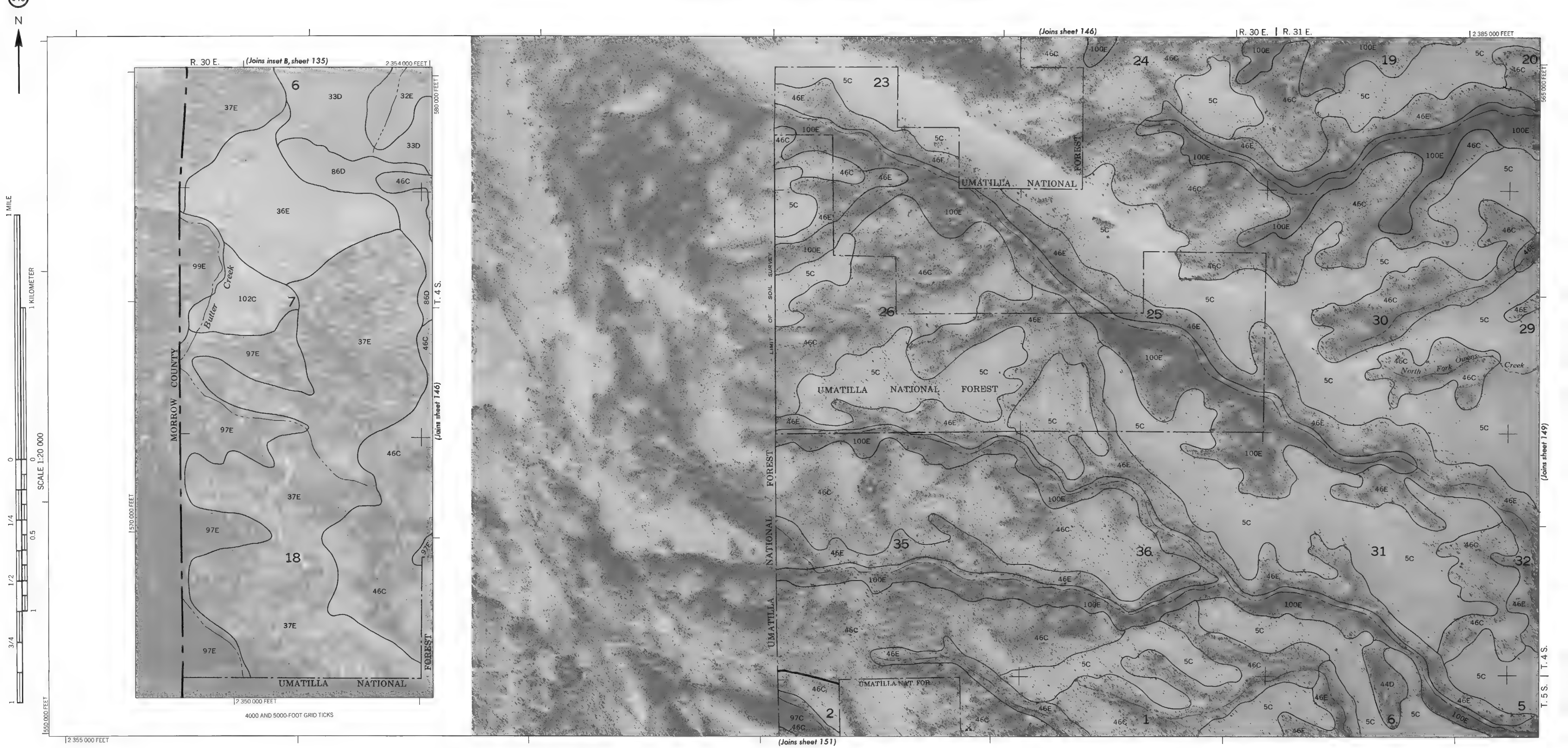

R. 31 E.
R. 32 E.
2 420 000 FEET
(Joins sheet 138)
610 000 FEET
T. 3 S.
(Joins sheet 142)
(Joins sheet 145)
2 450 000 FEET
600 000 FEET
N
UMATILLA NATIONAL FOREST
UMATILLA NAT. FOR.
LIMIT OF SOIL SURVEY
West Birch Creek
Kenny Gulch
Coyote Gulch
Merle Gulch
Stanley Creek
Table Mountain
Bridge Creek
Sagebrush Flat
Bradley Flat
South Prairie
Lower Bench
Upper Bench
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
1
1
5
4
3
2
8
9
10
11
14
15
16
17
32E
35F
13F
107F
126A
100E
45E
46C
5C
108F
46E
100C
107F
97E
97C
41F
46C

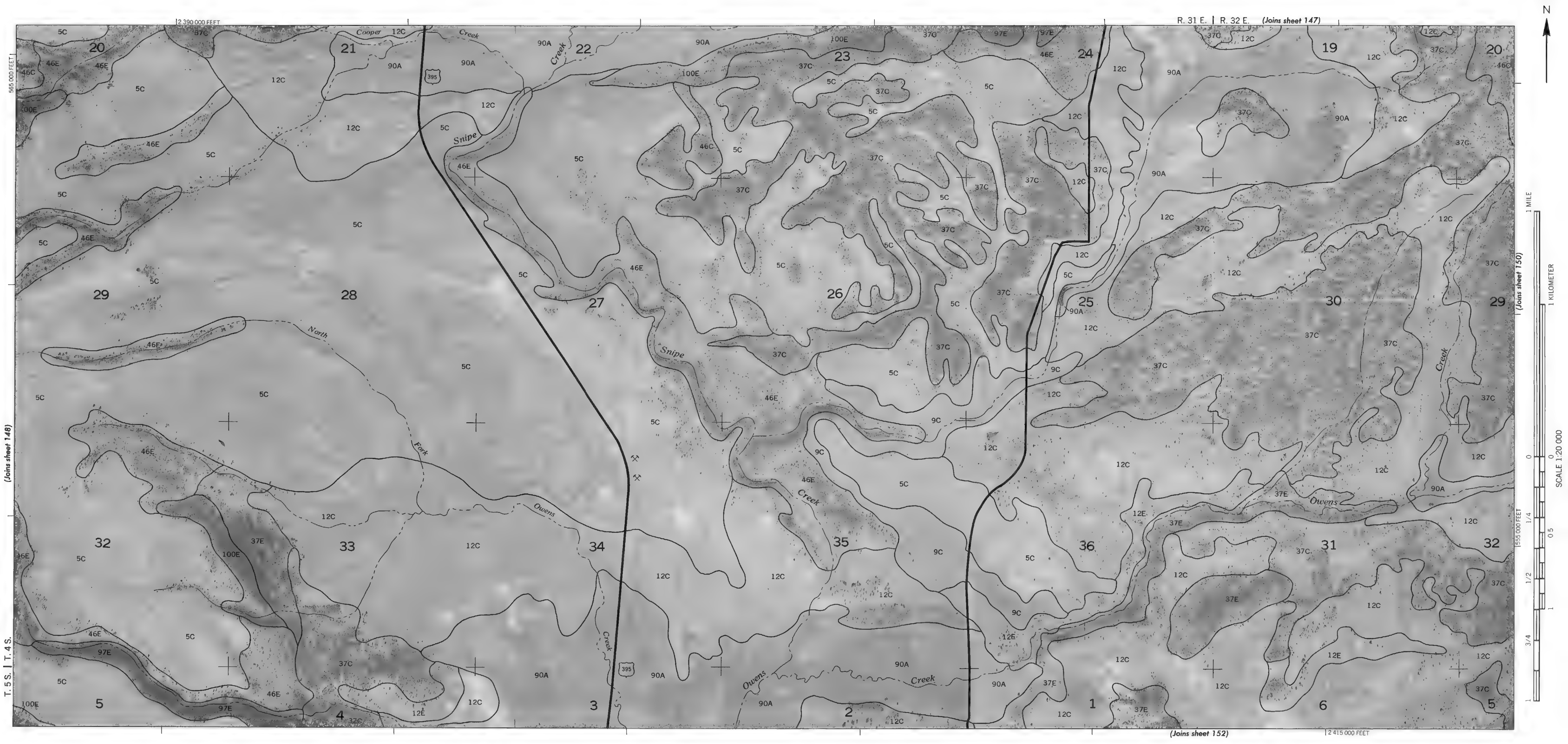

N
(Joins sheet 141)
(Joins sheet 146)
(Joins inset B, sheet 135)
(Joins sheet 145)
R. 30 E. | R. 30 1/2 E.
R. 31 E. | R. 30 E.
T. 4 S. | T. 3 S.
2 385 000 FEET
2 355 000 FEET
595 000 FEET
585 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
Spring Hollow
Ely Creek
Monahan Creek
Buckhorn
Creek
Gurdane
Gurdane Creek
East Fork Butter Creek
Butter Creek
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
2
3
4
5
6
1

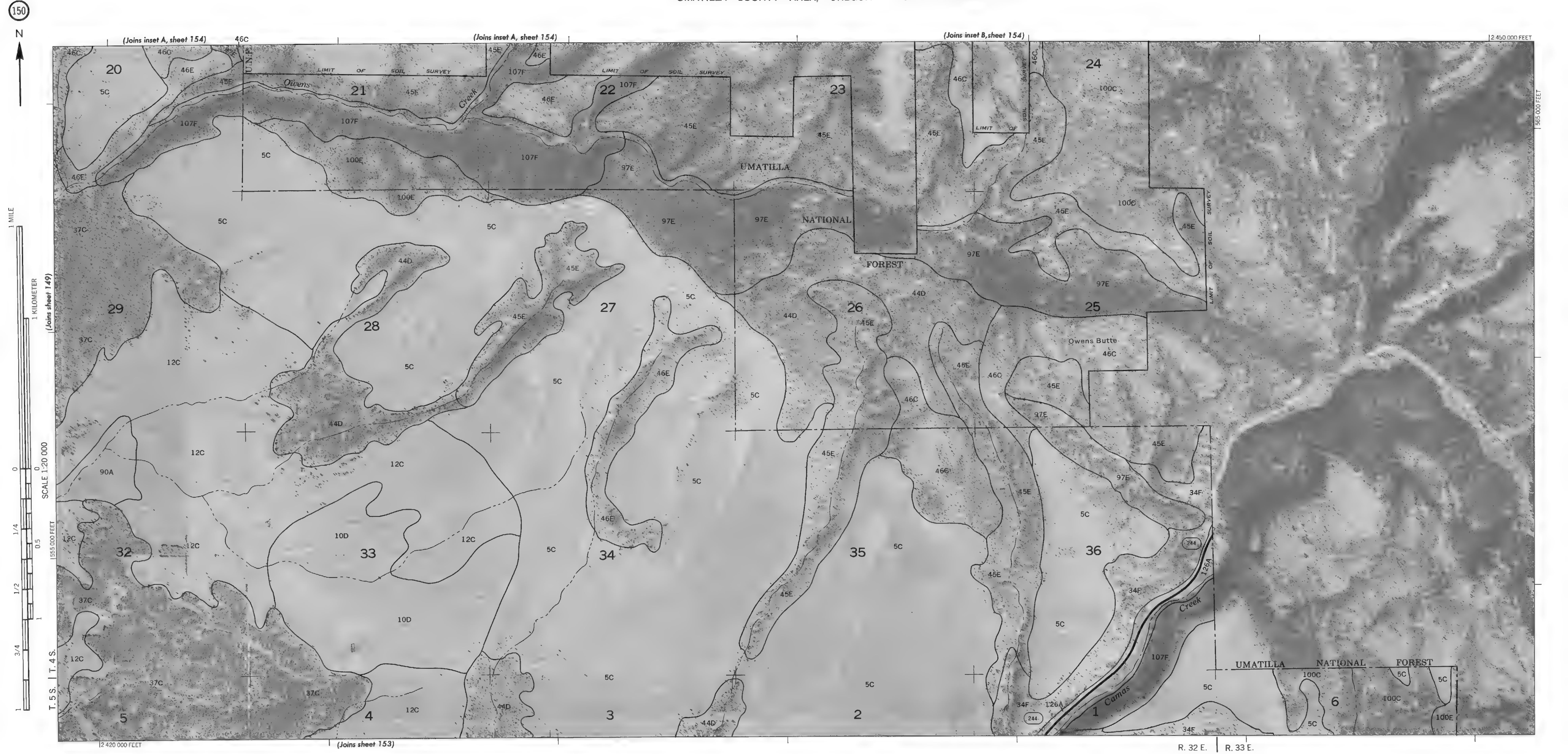

R. 30 1/2 E. | R. 31 E.
2 390 000 FEET
(Joins sheet 142)
(143)
N
(Joins sheet 144)
(Joins sheet 147)
2 415 000 FEET
SCALE 1:20 000
T. 3 S.
T. 4 S.
Alexander Creek
Canyon
Tunnel
Snipe Creek
Carney Butte
Bear Creek
Swiss Flat
UMATILLA NATIONAL FOREST
395

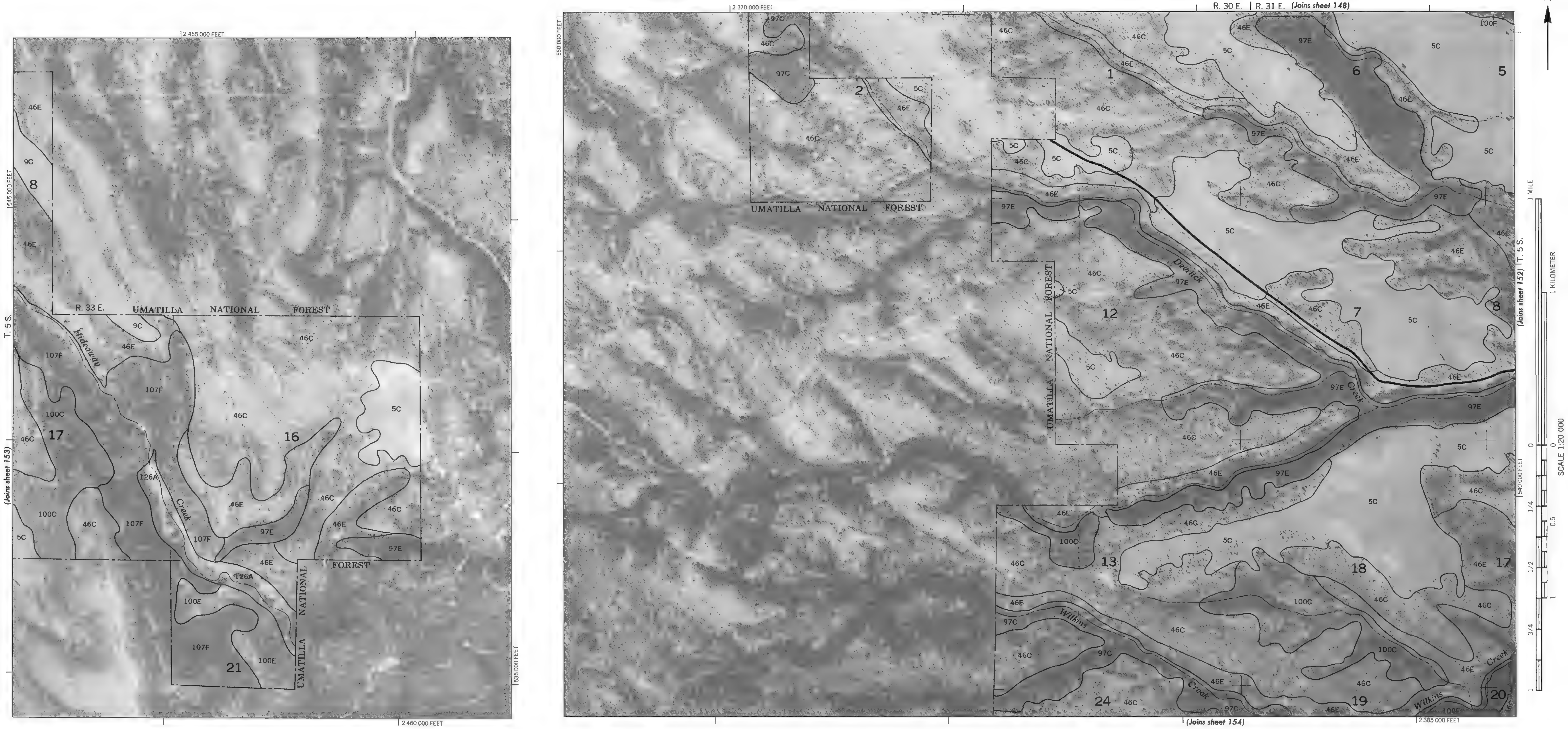

N
(Joins sheet 144)
R. 30 E.
R. 31 E.
2 385 000 FEET
T. 4 S.
(Joins sheet 147)
(Joins sheet 148)
(Joins inset, sheet 148)
2 355 000 FEET
570 000 FEET
SCALE 1:20 000
1 MILE
1 KILOMETER
Reservoir
Buckhorn Creek
Gurdane Creek
Butter Creek
East Fork
The Big Pot
Cooper Creek
UMATILLA NATIONAL FOREST
UMATILLA
NATIONAL
FOREST
5C
32E
33D
36E
37C
37E
40C
40E
46C
46E
86D
90A
97E
100C
100E
107F


147
N
(Joins sheet 145)
2 390 000 FEET
580 000 FEET
T. 4 S.
(Joins sheet 146)
West Fork
Snipe Creek
Snipe Creek
Cooper Creek
395
UMATILLA NAT. FOR.
LIMIT OF SOIL SURVEY
U.N.F.
UMATILLA NATIONAL FOREST
UMATILLA NAT. FOR.
Albee
570 000 FEET
(Joins inset A, sheet 154)
R. 31 E. | R. 32 E.
(Joins sheet 149)
2 415 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000

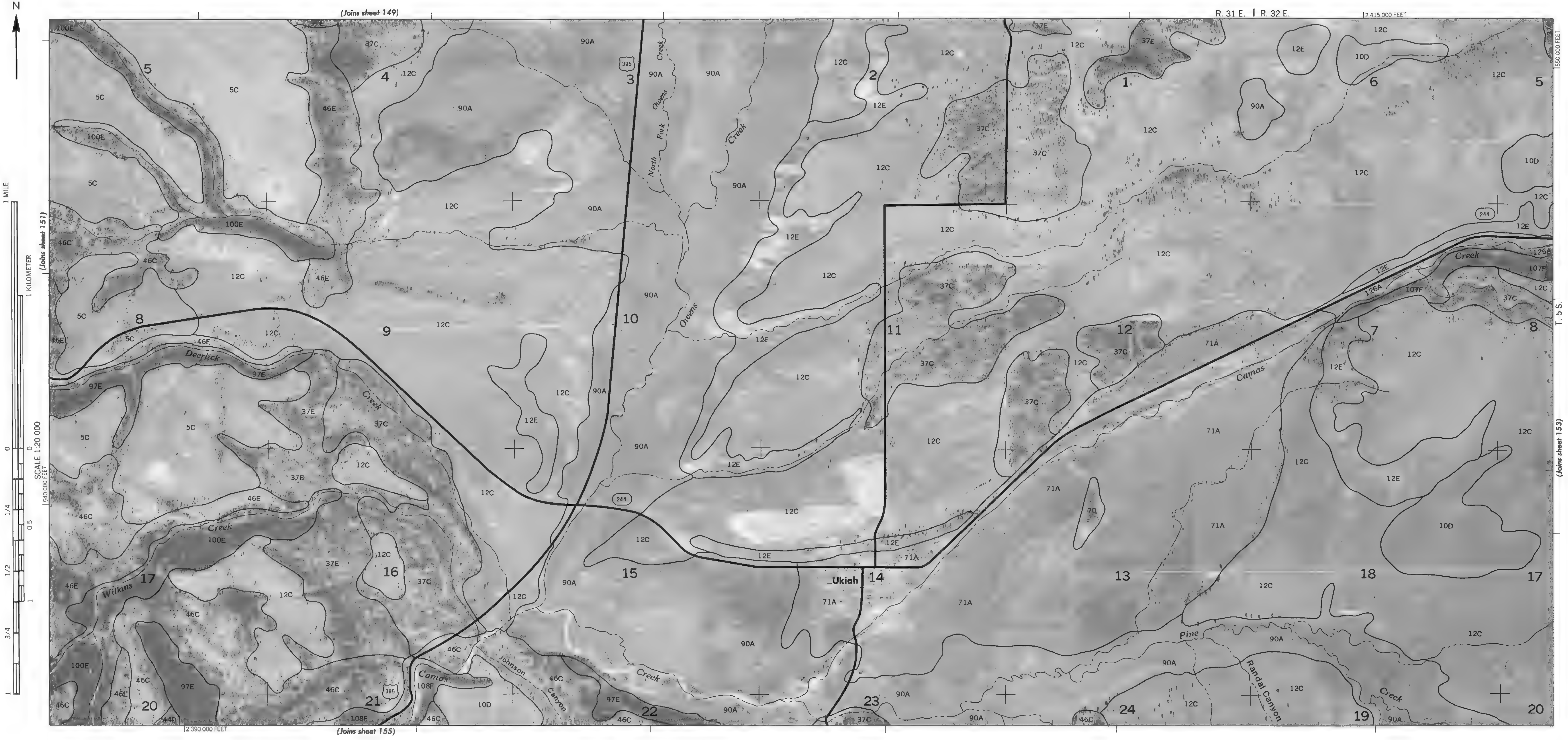

N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins inset B, sheet 135)
R. 30 E.
2 354 000 FEET
580 000 FEET
570 000 FEET
550 000 FEET
2 350 000 FEET
2 355 000 FEET
4000 AND 5000-FOOT GRID TICKS
MORROW COUNTY
Butter Creek
T. 4 S.
(Joins sheet 146)
UMATILLA NATIONAL FOREST
(Joins sheet 146)
R. 30 E.
R. 31 E.
2 385 000 FEET
565 000 FEET
(Joins sheet 149)
(Joins sheet 151)
T. 4 S.
T. 5 S.
LIMIT OF SOIL SURVEY
UMATILLA NATIONAL FOREST
UMATILLA NAT. FOR.
North Fork Owens Creek
6
7
18
23
24
19
20
26
25
30
29
35
36
31
32
1
2
5
6
33D
32E
86D
46C
36E
99E
102C
97E
37E
86D
97E
5C
46E
100E
46C
44D
97C

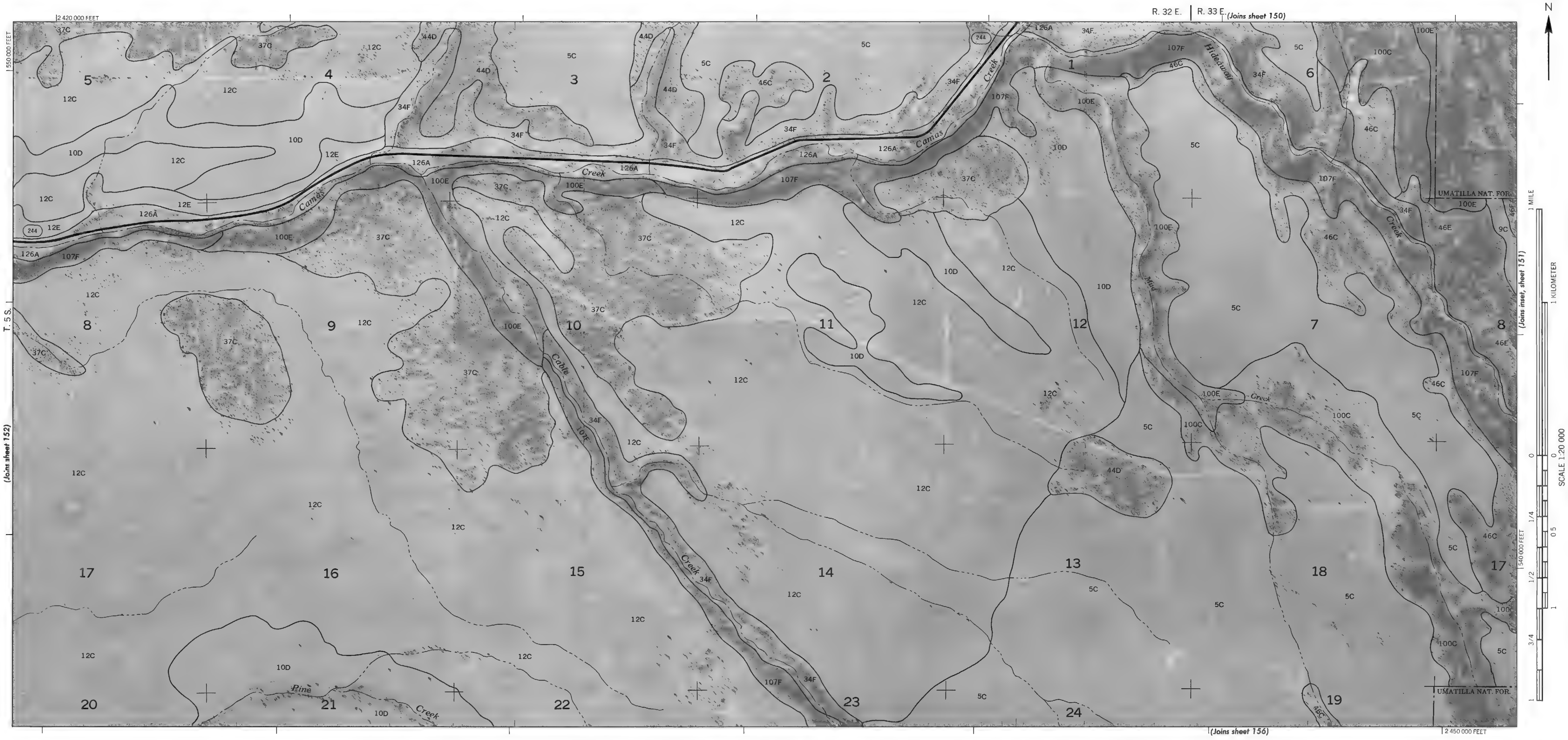

N
R. 31 E. | R. 32 E.
(Joins sheet 147)
(Joins sheet 148)
(Joins sheet 150)
(Joins sheet 152)
T. 5 S. | T. 4 S.
2 390 000 FEET
2 415 000 FEET
565 000 FEET
555 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
Cooper Creek
Snipe Creek
North Fork Owens Creek
Owens Creek
Creek
395
20
21
22
23
24
19
29
28
27
26
25
30
32
33
34
35
36
31
5
4
3
2
1
6
5C
12C
37C
46E
46C
100E
90A
97E
37E
9C
12E

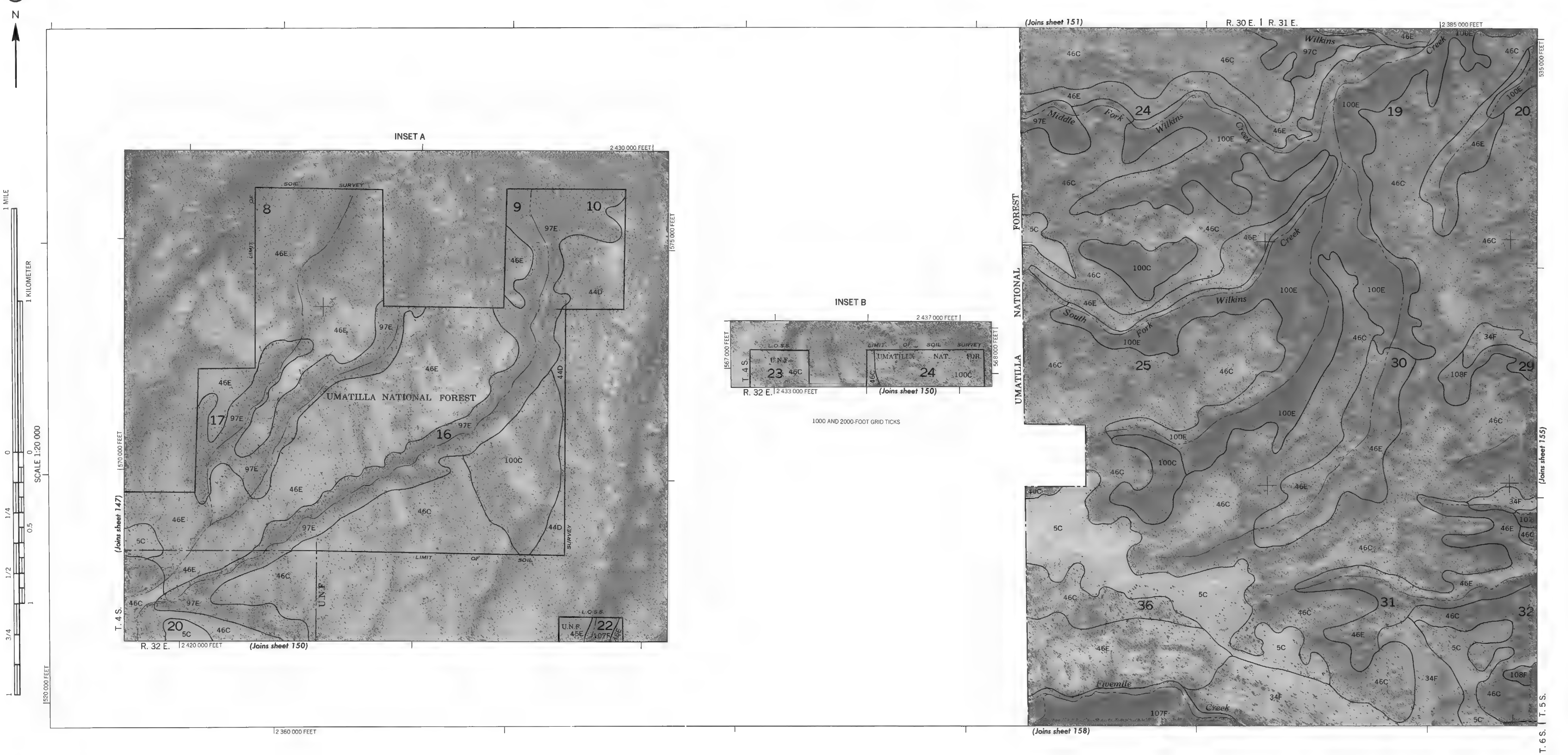

150
N
(Joins inset A, sheet 154)
(Joins inset A, sheet 154)
(Joins inset B, sheet 154)
(Joins sheet 149)
(Joins sheet 153)
LIMIT OF SOIL SURVEY
UMATILLA
NATIONAL
FOREST
UMATILLA NATIONAL FOREST
Owens Creek
Camas Creek
Owens Butte
1 MILE
1 KILOMETER
SCALE 1:20 000
T. 4 S.
T. 5 S.
R. 32 E.
R. 33 E.
2 420 000 FEET
2 450 000 FEET
555 000 FEET
565 000 FEET

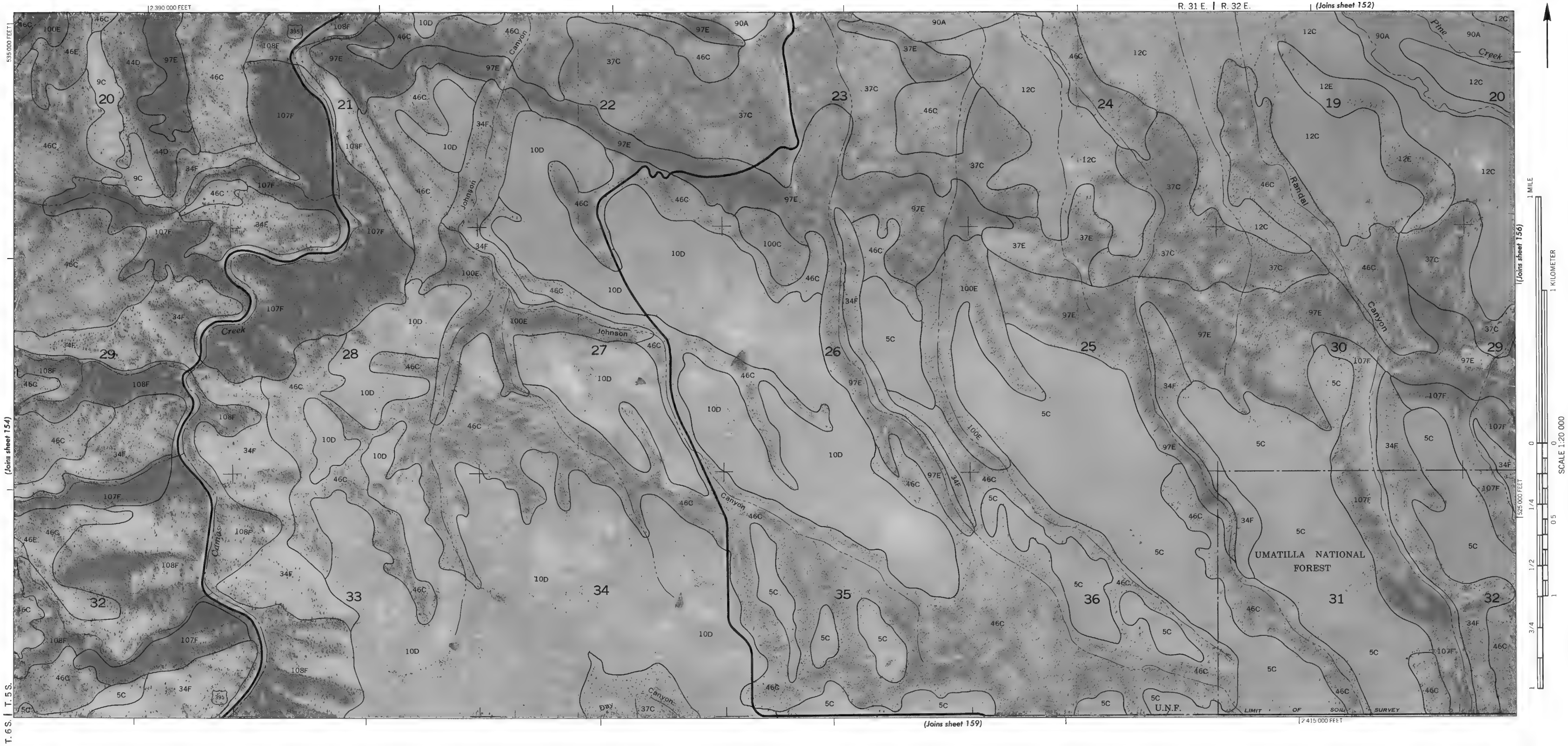

151
N
R. 30 E. | R. 31 E. (Joins sheet 148)
(Joins sheet 152) T. 5 S.
(Joins sheet 154)
(Joins sheet 153)
T. 5 S.
R. 33 E.
UMATILLA NATIONAL FOREST
Deerlick Creek
Wilkins Creek
Hideaway Creek
2 370 000 FEET
2 385 000 FEET
2 455 000 FEET
2 460 000 FEET
550 000 FEET
545 000 FEET
540 000 FEET
535 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000

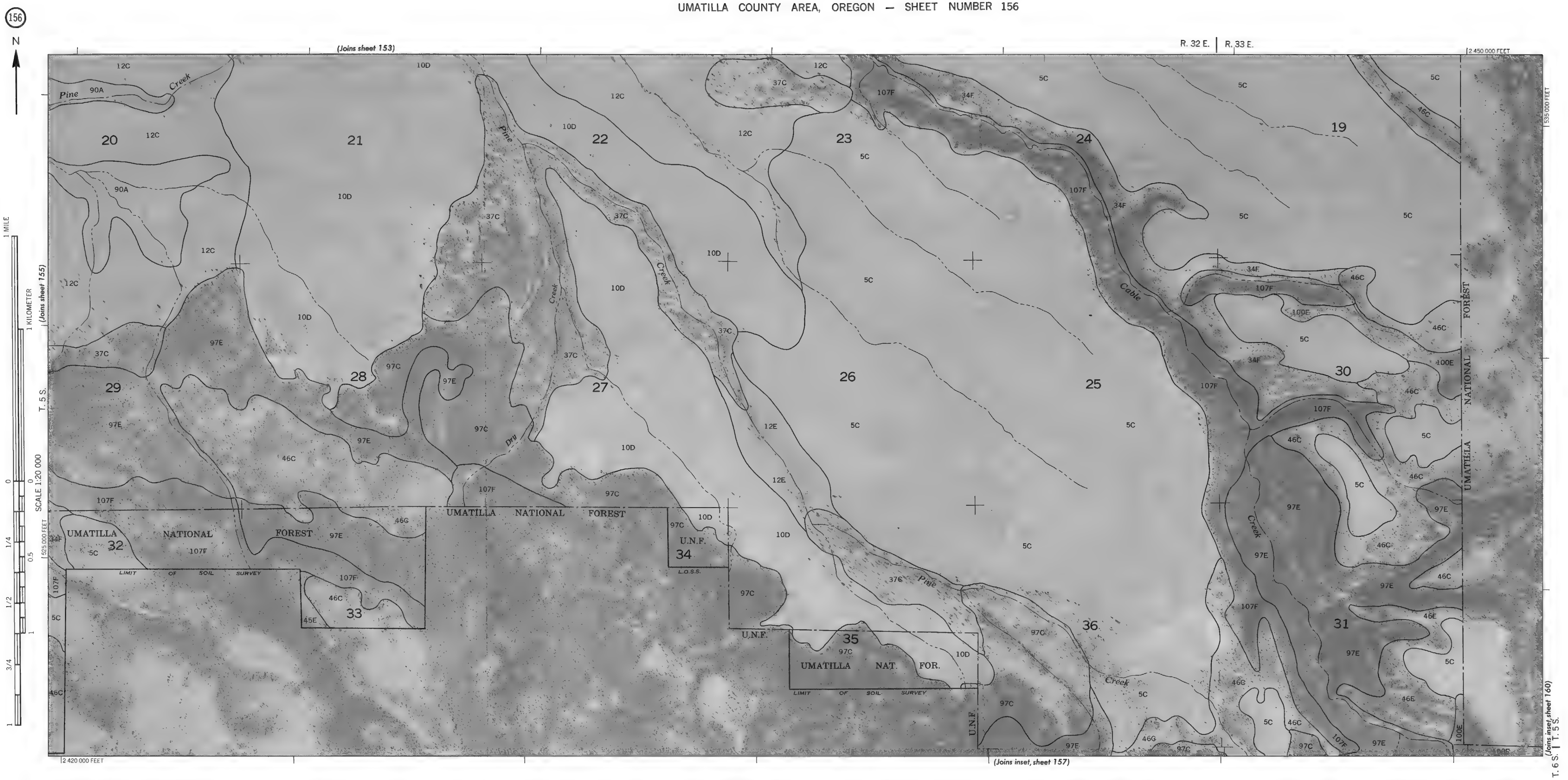
UMATILLA COUNTY AREA, OREGON — SHEET NUMBER 152




153
N
R. 32 E.
R. 33 E.
(Joins sheet 150)
(Joins sheet 152)
(Joins inset, sheet 151)
(Joins sheet 156)
2 420 000 FEET
2 450 000 FEET
550 000 FEET
540 000 FEET
T. 5 S.
UMATILLA NAT. FOR.
Camas Creek
Hideaway Creek
Mud Creek
Cable Creek
Pine Creek
244
SCALE 1:20 000
1 MILE
1 KILOMETER

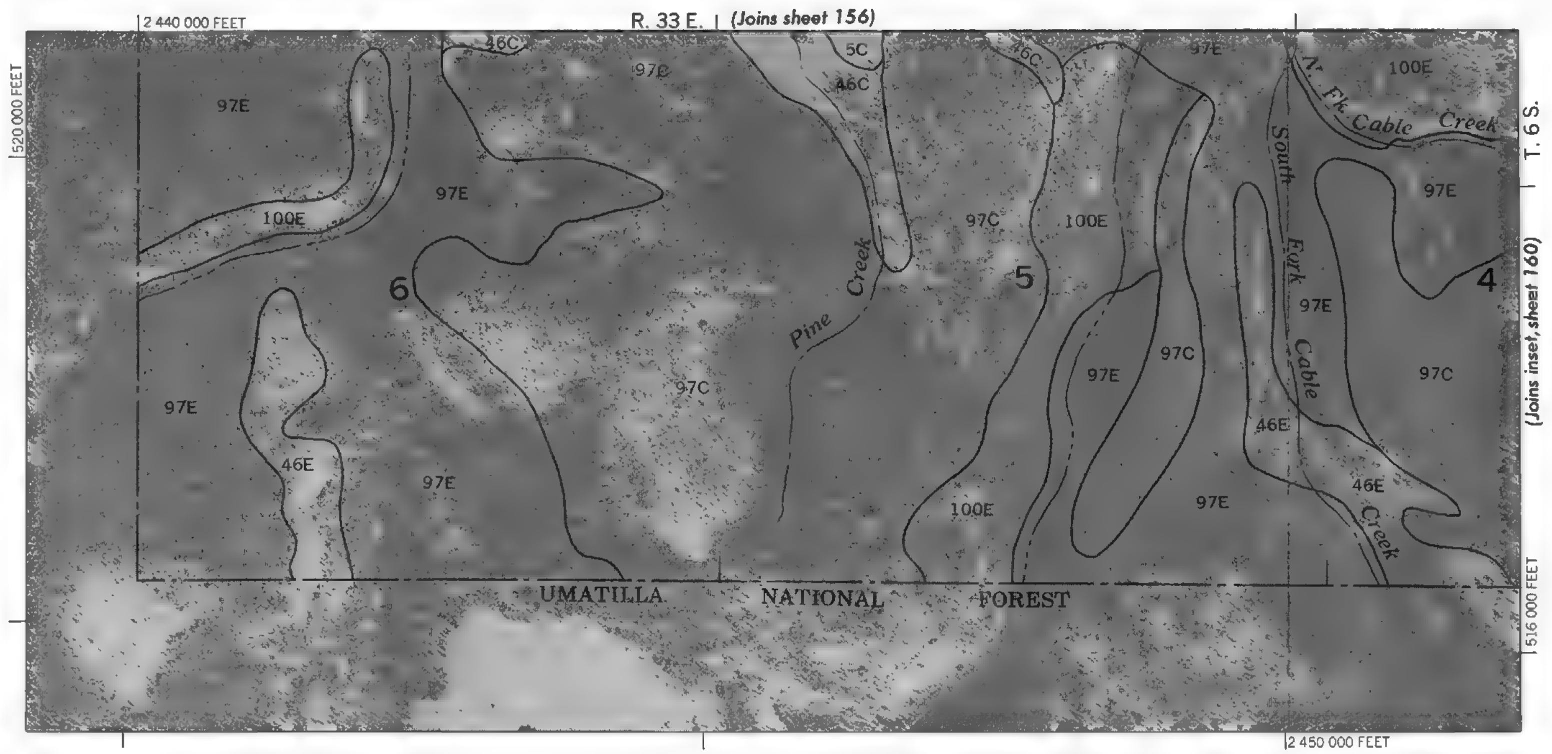

N
INSET A
INSET B
UMATILLA NATIONAL FOREST
LIMIT OF SOIL SURVEY
(Joins sheet 147)
(Joins sheet 150)
(Joins sheet 151)
(Joins sheet 155)
(Joins sheet 158)
R. 30 E. | R. 31 E.
R. 32 E.
T. 4 S.
T. 5 S.
T. 6 S.
2 430 000 FEET
2 420 000 FEET
2 437 000 FEET
2 433 000 FEET
2 385 000 FEET
2 360 000 FEET
575 000 FEET
570 000 FEET
567 000 FEET
568 000 FEET
535 000 FEET
520 000 FEET
1000 AND 2000-FOOT GRID TICKS
SCALE 1:20 000
1 MILE
1 KILOMETER
Middle Fork Wilkins Creek
South Fork Wilkins Creek
Wilkins Creek
Fivemile Creek
UMATILLA NAT. FOR.
U.N.F.
L.O.S.S.


2 390 000 FEET
535 000 FEET
R. 31 E. | R. 32 E.
(Joins sheet 152)
(Joins sheet 154)
(Joins sheet 156)
(Joins sheet 159)
N
1 MILE
1 KILOMETER
SCALE 1:20 000
525 000 FEET
2 415 000 FEET
T. 5 S.
T. 6 S.
UMATILLA NATIONAL FOREST
U.N.F.
LIMIT OF SOIL SURVEY
Camas Creek
Johnson Canyon
Randal Canyon
Pine Creek
Day Canyon
395
20
21
22
23
24
19
29
28
27
26
25
30
33
34
35
36
31
32

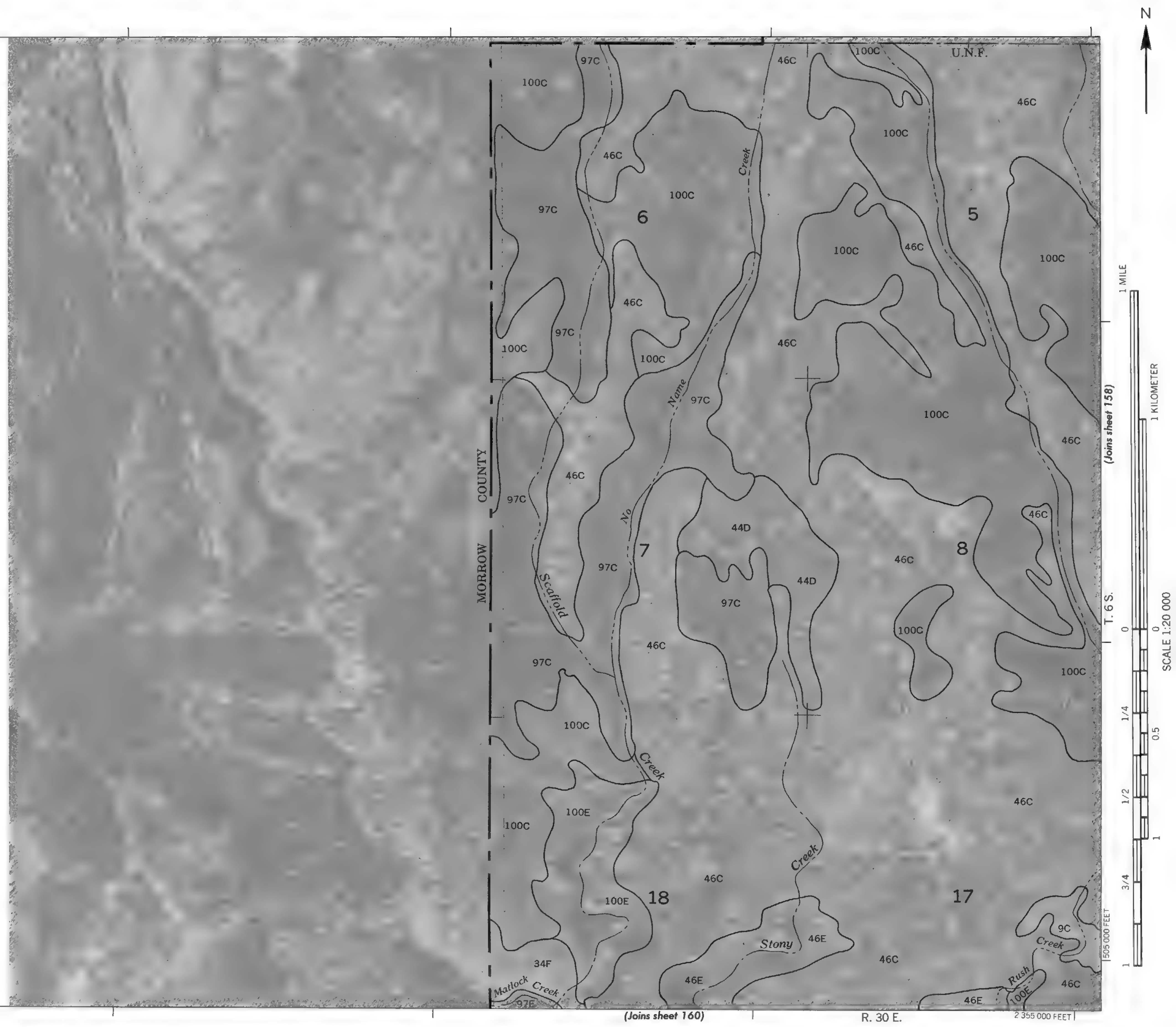

156
N
(Joins sheet 153)
R. 32 E.
R. 33 E.
2 450 000 FEET
535 000 FEET
(Joins sheet 155)
T. 5 S.
1 MILE
1 KILOMETER
SCALE 1:20 000
525 000 FEET
2 420 000 FEET
(Joins inset, sheet 157)
(Joins inset, sheet 160)
T. 5 S.
T. 6 S.
Pine Creek
Dry Creek
Cable Creek
Creek
UMATILLA NATIONAL FOREST
U.N.F.
UMATILLA NAT. FOR.
LIMIT OF SOIL SURVEY
L.O.S.S.
20
21
22
23
24
19
29
28
27
26
25
30
32
33
34
35
36
31
12C
90A
10D
37C
107F
34F
5C
46C
97E
97C
100E
12E
45E
46G

2 325 000 FEET

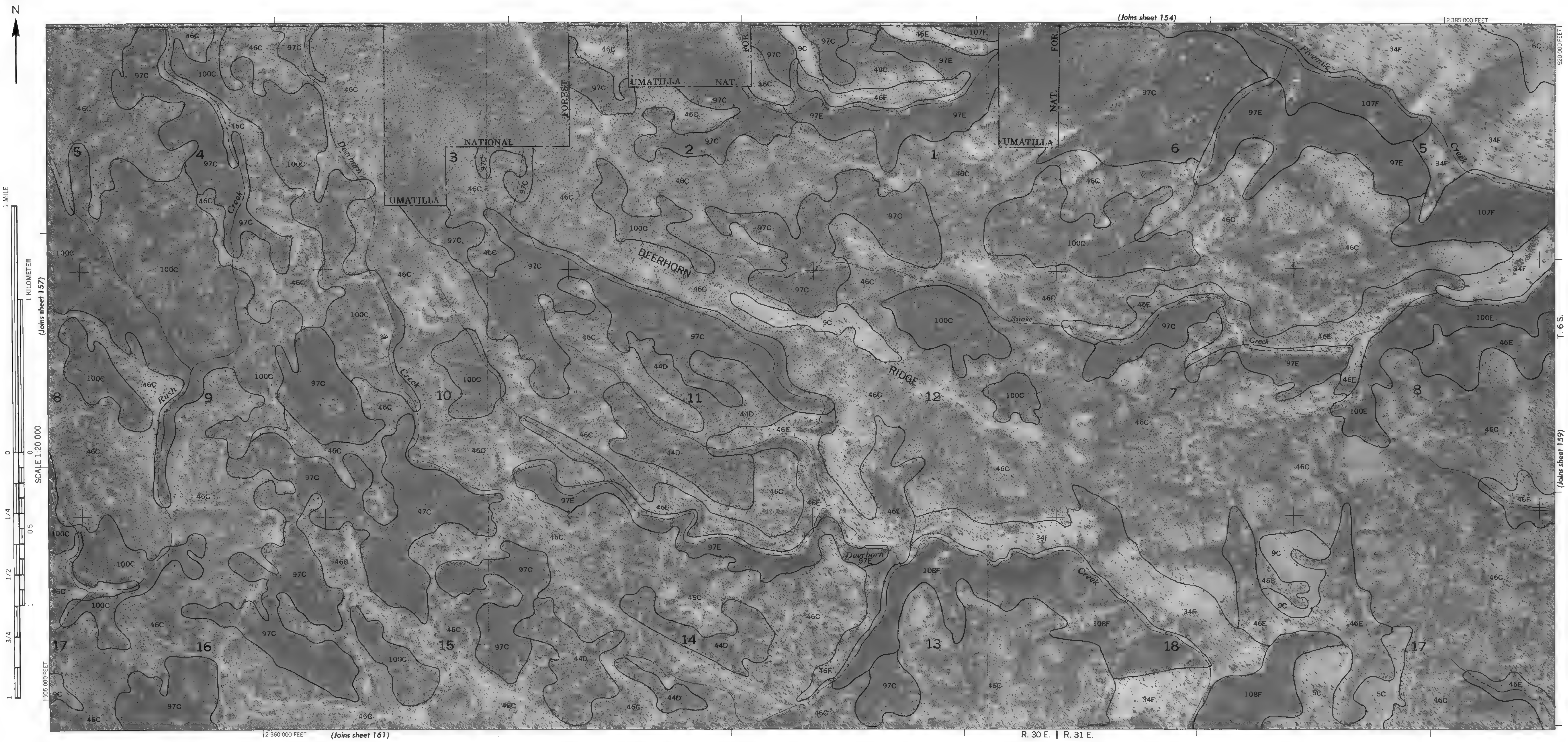
515 000 FEET



4000 AND 5000-FOOT GRID TICKS

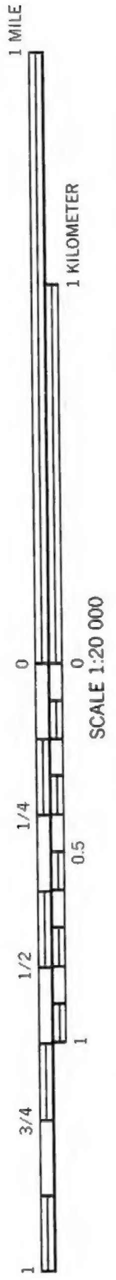


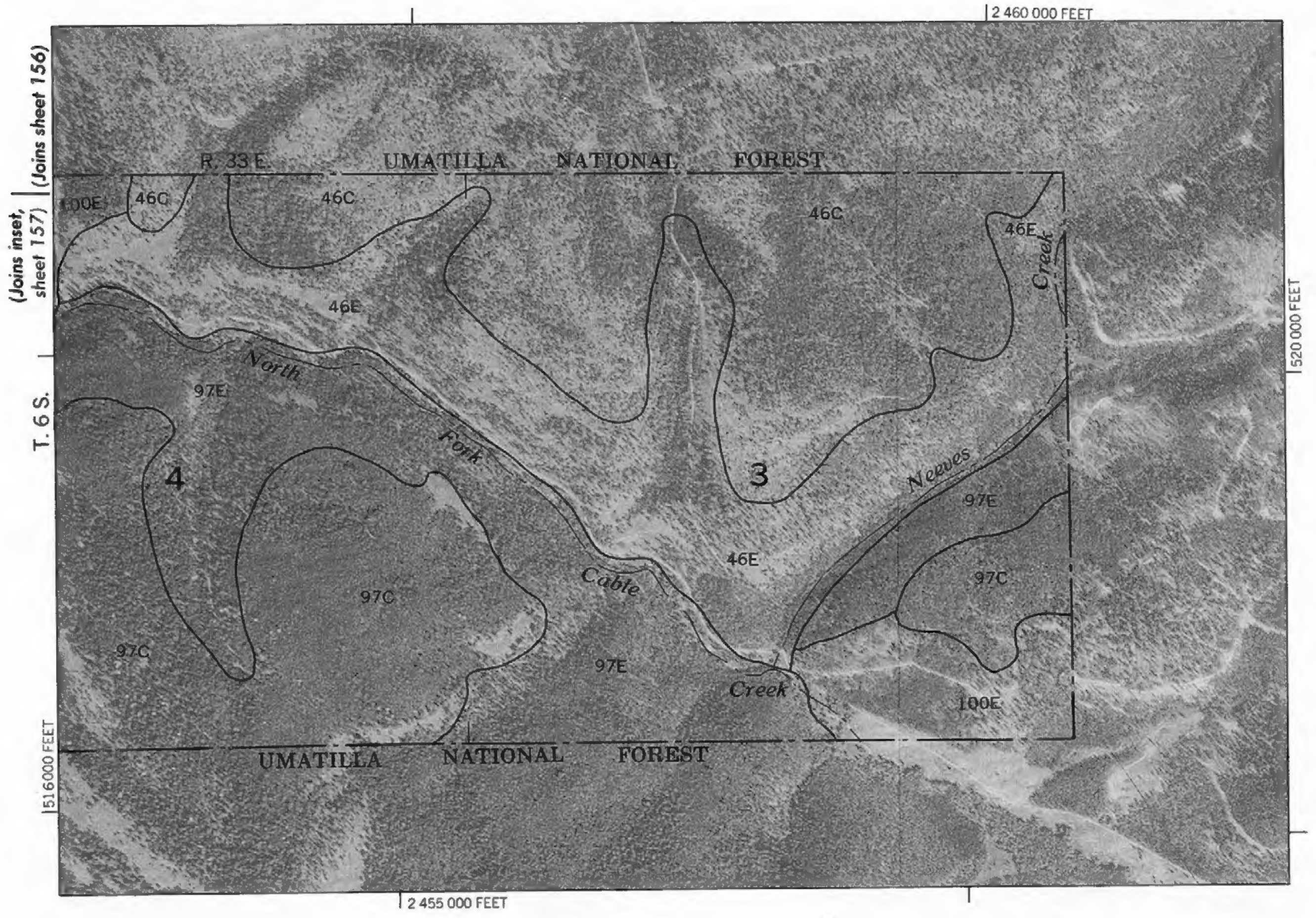
UMATILLA COUNTY AREA, OREGON — SHEET NUMBER 158




159
N
2 390 000 FEET
(Joins sheet 155)
520 000 FEET
T. 6 S.
(Joins sheet 158)
(Joins sheet 162)
R. 31 E.
R. 32 E.
2 420 000 FEET
510 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
Fivemile
Creek
Camas
Creek
Canyon
Day
Bridge
Creek
Chitsen
UMATILLA NATIONAL FOREST
UMATILLA
NATIONAL
FOREST
LIMIT OF SOIL SURVEY
Bridge Creek Flats
395
1
2
3
4
9
10
11
12
13
14
15
16
18
5C
34F
108F
107F
10D
37C
107E
100E
35F
46E
46C
97E
12C
100E

N





4000 AND 5000-FOOT GRID TICKS


2 360 000 FEET
R. 30 E.
R. 31 E.
(Joins sheet 158)
(Joins sheet 162)
(Joins sheet 160)
T. 6 S.
500 000 FEET
450 000 FEET
GRANT COUNTY
N
1 MILE
1 KILOMETER
SCALE 1:20 000
Buckaroo
Flat
Creek
Buckaroo
Jericho
Creek
Deerhorn
Creek
NORTH FORK JOHN DAY RIVER
Bone Canyon
46C
97C
44D
9C
5C
34F
108F
107F


162
N
(Joins sheet 159)
R. 31 E.
R. 32 E.
2 420 000 FEET
505 000 FEET
490 000 FEET
(Joins sheet 161)
T. 6 S.
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
LIMIT OF SOIL SURVEY
UMATILLA NATIONAL FOREST
Flats
Bridge Creek
Stover Canyon
Camas Creek
Chilson Creek
North Fork John Day River
GRANT COUNTY
395
19
20
21
22
23
24
25
26
27
28
29
30
31
33
34
35
36
5C
46C
46E
97E
10D
12C
34F
35F
37C
37E
107F
108F